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KEY (K. H. L.). **A Critique on the Phase Theory of Locusts.**—*Quart. Rev. Biol.* **25** no. 4 pp. 363–407, 1 fig., 3 pp. refs. Baltimore, Md., 1950.

The author reviews from the literature the development of the theory of the occurrence of phases in locusts since it was first propounded [R.A.E., A 9 561], with reference to the characters and differentiation of the phases, the mechanism of phase transformation in the field and the laboratory, and the relation of phases to the development of outbreaks and their periodicity. He concludes that the theory has never been succinctly formulated, although its basic content can be inferred, and that the subordinate concepts and terminology have not been precisely defined. This has resulted in an unjustifiably wide interpretation of the scope of the theory, numerous logical inconsistencies, and misplaced conceptions of its importance in the study of outbreaks. He accordingly defines the terminology and limits the theory as follows: In certain animals, different degrees of mutual stimulation between the individuals composing populations of different densities lead to the appearance of distinct physical types, the "phases", which typically differ also in physiology and behaviour. The phases may, within one or several generations, be transformed one into the other by an alteration in the degree of mutual stimulation.

The term "phase" applies to a type of individual, and the phases *solitaria*, *transiens* and *gregaria* to the types of individual characteristic of specified levels of gregariousness, although in a particular situation any one of them may exhibit any level of gregariousness. Phase *gregaria* is characteristic of swarms, and therefore cannot occur in any species that does not form swarms. The categories *congregans* and *dissocians* are not phases, and other terms should be used for them. A population cannot have a phase unless it is completely homogeneous, but heterogeneous populations can have "phase status" based upon the phases of their component individuals or such properties as the ratio of sexual dimorphism.

In order to avoid the confusion that has arisen in the past from the low correlation between the different phase characters of the individual phases, the author proposes to define the three phases of a given species by fixed contiguous ranges of the single morphometric character that best differentiates them in that species. He describes a procedure for selecting this best indicator and for determining the ranges appropriate to each phase. Nymphs, adults of which certain parts are damaged or preserved in such a manner that they cannot be measured and individuals of any species of which the phases have not been sufficiently studied cannot be classified into any phase under this system. He proposes the terms solitarioid, transientoid and gregarioid, not italicised and not prefixed by the word "phase," for indicating the general phase affinities of such examples, but suggests that the phase terminology could probably be dispensed with altogether in ecological and epidemiological studies, though it has taxonomic value.

In a discussion of the outbreak process, the author analyses the component operative processes involved [cf. **28** 29; **31** 522; **33** 201, etc.]. The essential process is a vicious circle of swarm formation, which is a phenomenon purely of behaviour. The physical phase differences are a secondary consequence of the outbreak process and play no important part in promoting either further phase transformation or further development of the outbreak process. A behaviour classification, independent of the phase classification, into "swarming" and "non-swarming" individuals is proposed.

The part played by outbreak areas and outbreak centres in promoting the multiplication of locusts has received little recognition, in spite of its fundamental importance. Multiplication, assisted to a varying degree by the stimulus to migration afforded by concentration and the consequent development of

gregariousness, is the real pre-condition of an outbreak, and not phase transformation. This pre-condition is best described as "swarm-formation." "Outbreak centres" are defined as areas of which the ecological conditions sometimes lead to swarm-formation and of which all parts contribute to this effect [cf. 35 134], and "outbreak areas" as areas containing numerous outbreak centres interspersed with non-outbreak-centre country and usually separated from the surrounding country by relatively sharp discontinuities in frequency of outbreak centres and in topographical features (including soil and vegetation, as well as physiography). Other distributional terms are also defined on the basis of the contrast between swarming and non-swarming populations.

KENNEDY (J. S.). *The Migration of the Desert Locust (*Schistocerca gregaria* Forsk.)*. I. The Behaviour of Swarms. II. A Theory of Long-range Migrations.—*Philos. Trans. (B)* 235 no. 625 pp. 163–290, 14 figs., 4¼ pp. refs. London, 1951.

In these first two parts of a series on migration in *Schistocerca gregaria* (Forsk.) the author discusses the migratory behaviour of the fully swarming locusts and a theory of long-range migration based on it. The third is to be devoted to migration in the non-swarming locusts. The following is based on the author's summary of the first part. New evidence is given on the behaviour of migrating swarms of *S. gregaria* based upon some 60 encounters by various observers with swarms in Persia in 1943 and in Kenya in 1944, and on the process by which a swarm launches on migration in the morning [cf. *R.A.E.*, A 37 120], which is described. Migratory activity increased gradually after the last moult, but whereas the tendency to fly reached full development before the cuticle had completely hardened, flight vigour, as shown by the ability to resist carriage by the wind, did not reach its maximum till later. Migratory activity continued until death, but was reduced during mating and oviposition. Close, continuous observations of single swarms suggested that low-flying locusts tend to maintain a constant speed relative to the ground regardless of wind speed; they tend to come down and even settle when the wind is too strong for them to progress against it, to take off and rise in the air when the wind speed is lower, and to orientate into the wind as long as they can make headway but to turn aside and commonly to turn right round and fly with the wind when they can no longer progress against it and do not settle. Locusts flying rather higher behaved similarly, but were distinctly less responsive to wind changes. When parts of the same swarm were observed over land and over water, those over land did not respond to wind changes when those over water did so. Mutual stimulation among swarm members was observed to reinforce flight activity, to make the locusts keep together and fly in parallel, thereby stabilising the direction of the swarm as a whole (gregarious inertia [cf. 34 352]), and to accelerate mass changes of direction initiated by external agencies such as wind. There was no consistent relation between the direction of the sun's rays and the locusts' orientation, but there was evidently some direction-stabilising agency other than gregarious inertia, and reasons are given for supposing this to be a light compass reaction to the sun. Evidence was obtained that the avoidance of upstanding obstacles is merely a special case of a general effect, a compensatory change of direction being caused by any gross movement across the eyes. This type of optomotor reaction is regarded as contributing to the observed tendency to fly along lanes, through trees, and along shore-lines and valleys.

These observations and those of other investigators are critically reviewed and further analysed, temperature and moisture also being considered. When wind speed and height of flight are taken into account, indications of a regular

system of relations between flight direction and wind direction become apparent. The wind appears to be a most important agency determining direction, and it acts not only by carrying the insects, but through the optomotor reactions of the insects to the apparent movement of the visible substrate. Migratory flight occurs as the normal activity of gregarious locusts when at or near their preferred temperature. The suddenness of the mass departure of a swarm in the morning is attributed primarily to gregariousness. As flight activity increases with rising temperature, mutual stimulation among the locusts also increases, and finally results in the formation of a coherent swarm, for the first time able to move as an entity and obliged to do so.

The primary characteristic of behaviour peculiar to migrant locusts, whether hopper or adult, is persistent locomotion continued throughout each successive day, to which other forms of activity are temporarily subordinated. The tendency to move in a straight line, which is often regarded as an equally fundamental characteristic of large insect migrants, appears to be secondary and an outcome of the locomotory drive. Locust migrants have no goal and no special directional sense, and their orientations are governed by reactions, mainly of the optomotor type, to fellow individuals, the sun, the wind, and other gross features of the environment. A peculiar feature of the migrant in this connection is the unfamiliar pattern in which familiar reactions are arranged, resulting in some changes in direction, but also in an unusual amount of moving steadily in one direction. This pattern seems to be due to the combination of the peculiar neuro-physiological state of the migrant, in which reactions to stimuli that would arrest it are suppressed, with the peculiar pattern of its sensory experience during continuous locomotion. Thus, external features that are the most constant concomitants of the moving insect, such as wind, sun and other locusts, become especially effective as sources of stimulation when their relation to the insect is changed, its reactions to them having thus a certain stabilising influence on its direction. The tendency of the migrant to stabilise its sensory relations with the environment is shared by non-migrating insects, and is no more peculiar to the migrant than are the types of regulatory reaction employed. - It is concluded that the key to locust migratory behaviour in all its aspects is the opposition between the tendency to locomotion and the tendency to sensory regulation, and that maintaining a straight course is one of the ways in which this conflict is resolved.

The following is based on the author's summary of the second part. Cartographical analysis of the seasonal and geographical patterns of migration by *S. gregaria* indicates that wind is of primary importance in the determination of long-range migrations. Cartographical and behavioural analyses show that the consistency of direction responsible for long-range trends is not created in the same way as the striking stability and unanimity of direction immediately observable during flights over short distances already considered. Long-range movements are resultant trends emerging from more or less confused movements. Displacement of the locusts through forward flight and displacement by wind are both common and can continue for long periods. Wind-dominated displacement could create a long-range trend, and behaviour observations indicated that locust-dominated displacement could also create a trend, though only under the influence of wind. The following theory of long-range migration is, therefore, put forward.

Displacement due to the exertions of the locusts can develop into a geographical trend if they persistently resist carriage on the wind and make progress against it, actively orientating into it at least intermittently. Displacement due to wind carriage can develop into a trend if the locusts persistently fly, but signally fail to resist carriage by the wind and go with it. There seems to be no other basis of long-range trend-creation. Locust-controlled and wind-controlled displacement tend to be up- and down-wind, respectively, and an

actual geographical trend appears when one predominates decisively over the other. External and internal factors can influence the resistance of the locusts to wind carriage and are termed "rectifiers"; an important means by which external factors influence resistance is by affecting the height at which the locusts fly, for the higher they fly the less they can resist wind carriage. Rectifiers neither cause nor direct displacement, but determine how fast and in which of various possible directions a trend will actually occur, and whether the locusts or the wind shall mainly affect displacement. The outstanding ones appear to be temperature, the age of the locusts and the wind itself. Steady and moderate winds, moderate temperatures, and the vigour of fully hardened locusts favour up-wind displacement, and gusty, stronger winds, high temperatures, active convection and the weakness of young locusts favour down-wind displacement. Geographical trends tend to parallel the prevailing wind direction, but do not always do so, since the most frequent wind may not be the one having the strongest rectifying qualities.

When a new generation of swarms is appearing at the start of a dry season, the high temperature and weakness of the locusts minimise their control over their displacement, rectify their displacement down-wind, and produce a spectacular geographical shift of the swarms. Such seasons alternate with seasons of more confused swarm movements, in which lower temperatures and the fully developed powers of the locusts combine to put them on a more equal footing with the wind, and the trends are sometimes up-wind and sometimes down-wind, often with neither predominating. The cartographical confusion among swarm movements during intermediate seasons is partly due to the transition from one prevailing wind-direction to another. Geographical redistribution of the swarm population is due in these seasons, more than in the others, to regional temperature differences; swarms disperse in and from warmer regions, where they fly often and change direction little, and become trapped in cooler, often mountainous, regions, where they fly less frequently and change direction more often. Multiplication and mortality, which are essential elements in the whole pattern of migrations, since they determine where swarms will be available to start migrating and where migrations must end for lack of migrants, are also influenced by environmental patterns, especially rainfall and temperature. Some trends are regularly abortive, since they do not lead to new breeding grounds, and others that do are regularly successful. Many successful and spectacular long-range movements are made when the insects have least control over their own displacement. The whole pattern involves the cyclical repetition of both abortive and successful trends.

When tested in a preliminary way against known examples of long-range migrations, this theory showed promise, but its validity cannot be properly assessed until more information has been amassed. Other views of insect migration are discussed in relation to it, and it is emphasised that, in essence, long-range migration trends are not behavioural, but ecological, events.

SEIXAS (C. A.). **Prova de bebida de cafés tratados com inseticidas para combate à broca.** [Tasting Tests on Coffee treated with Insecticides for the Control of the Borer.]—*Biológico* 14 no. 7 pp. 163-164, 1 ref. São Paulo, 1948.

In connection with experiments on the chemical control of the coffee berry borer [*Stephanoderes hampei* (Ferr.)] on coffee in São Paulo, Brazil [cf. *R.A.E.*, A 39 135, etc.], the effect of various treatments on the flavour of the prepared beverage was investigated in 1947-48. The bushes were dusted on six dates between 28th October 1947 and 17th February 1948 with 5 per cent. DDT, 0.25 per cent. parathion (Rhodiatox), or benzene hexachloride to give 2 per cent. γ isomer, all in talc; both the number of applications and the amounts applied were greater than would be the case in commercial treatment. The

berries were gathered on 12th March, treated in the normal manner and submitted to 13 organisations for taste tests. The results of these indicated no changes in flavour that could be attributed to the insecticide treatments.

FALANGHE (O.). **Constatação de uma coleobroca como praga de abacaxi.** [Observations on a Beetle Borer as a Pest of Pineapple.]—*Biológico* **14** no. 7 pp. 165–167, 1 pl., 1 fig., 4 refs. São Paulo, 1948.

Many pineapple plants growing at an Experiment Station at Limeira, São Paulo, were found in August 1946 to have been cut off at soil level by the larvae of *Paradiaphorus crenatus* (Billb.), which tunnelled into the stalks. Similar though less widespread damage occurred at other places. Observations showed that the weevils deposit their eggs in incisions in the region of the collar and that there were 1–6 larval galleries per plant. When the larvae become full fed, they cut the stem so that the upper part of the plant is supported only by a thin layer of bark, and pupate in this region. Plants so injured break off at the least shock, and infestation is difficult to detect until this occurs. A Portuguese translation of a description of the adult by Schoenherr is included.

TUFT (P. H.). **The Structure of the Insect Egg-shell in Relation to the Respiration of the Embryo.**—*J. exp. Biol.* **26** no. 4 pp. 327–334, 2 figs., 4 refs. London, 1950.

The following is the author's summary. The site of gaseous exchange in the eggs of *Rhodnius prolixus* Stål is shown to be the rim of the cap which covers the anterior end of the egg. Most of the oxygen consumed by the embryo enters the egg through the micropyles and pseudomicropyles which penetrate the shell in this region [*R.A.E.*, A **37** 110]. The physical conditions necessary for the passage of sufficient oxygen through these pores is discussed. A continuous gas space under the shell—the presence of which can be deduced on theoretical grounds—is shown to exist in the *Rhodnius* egg. The relationship between waterproofing and the permeability of the shell to oxygen is discussed.

Proceedings of the Eighth International Congress of Entomology, Stockholm, 1948.—1030 pp., illus., refs. Stockholm, 1950.

The communications made at this Congress are distributed among the following sections: general entomology (8 papers), systematic entomology (16 papers), physiology (22 papers), ecology and zoogeography (30 papers), morphology, anatomy and embryology (14 papers), agricultural pests (28 papers), forest entomology (13 papers), pests of stored products (6 papers), medical and veterinary entomology (7 papers), pest control (21 papers), nomenclature (6 papers), and Arachnida (7 papers). The following are abstracts of papers on agricultural pests that have not apparently been often referred to in the recent literature.

BETREM (J. G.). **The Control of the Mosquito Blight on the Cacao on Java,** pp. 593–596, 16 refs. Some of the information given in this paper on the control of *Helopeltis* on cacao in Java has been noticed from other sources [*R.A.E.*, A **23** 402; **27** 523; **30** 80]. *H. antonii* Sign. and *H. theivora* Waterh. are both common, but the former is the more abundant and injurious. It attacks and sometimes destroys the young shoots and also feeds on the pods in all stages of development. Experiments showed hand collection to be of no value in control on large trees. Fortnightly applications of a derris dust containing 0.75 per cent. rotenone begun when the bugs become too numerous

for the tree to resist the attack give satisfactory control [30 80] provided that the derris powder from which it is prepared has a rotenone content of at least 4 per cent. and that at least 90 per cent. of its particles pass a 200-mesh sieve. Talc and local volcanic ash were equally satisfactory as carriers in field experiments. The nymphs are parasitised by *Euphorus helopeltidis* Ferrière, which, however, is never sufficiently abundant to afford satisfactory control. Experiments by the author, P. Levert and G. Giesberger showed that when adults of *Helopeltis* were presented with pods from trees infested by *Pseudococcus lilacinus* (Ckll.) and *Dolichoderus bituberculatus* (Mayr) and with others from trees free from these insects, over 90 per cent. of the feeding punctures made by the Mirids were on the latter, so that the scarcity of *Helopeltis* in plantations in which *P. lilacinus* and *D. bituberculatus* are present [23 402] must be due to their requiring pods in different physiological conditions. Some reduction of *Helopeltis* by the ant (not exceeding 25 per cent.) is obtained when the pods are suitable for both *Helopeltis* and *P. lilacinus*. Dry weather during the east monsoon causes populations to die out almost completely in both the laboratory and the field, but during the succeeding west monsoon populations increase gradually and become injurious by February. If the east monsoon period is relatively wet, populations may be injurious as early as December. The weather evidently exercises its effect indirectly through the plant, since bugs reared at temperatures between 11 and 35°C. [51·8 and 95°F.] and relative humidities between 70 and 100 per cent., but receiving the same food, showed little difference in mortality or egg production.

FUKAYA (M.). **On the Factor inducing the Dormancy of the Rice Borer, *Chilo simplex* Butler**, pp. 223-225, 3 refs. The intensity of the damage to rice in Japan by first-generation larvae of *Chilo suppressalis* (Wlk.) (*simplex* (Btlr.)) is influenced by the date of emergence of the adults of the overwintered generation and that caused by the second-generation larvae by their abundance, and since the date of emergence may be affected by the diapause undergone by second-generation larvae in the preceding year, the factors inducing this were investigated. It is pointed out that the diapause also occurs commonly among larvae of the first generation, which develop while the temperature is still high. When eggs laid by females collected from a district where winter diapause is pronounced were kept at temperatures between 22 and 33·3°C. [71·6 and 91·94°F.] and the larvae that hatched from them were reared at 31 or 32°C. [87·8 or 89·6°F.], larvae from eggs kept at 22°C. all entered diapause, 16·1 per cent. of those from eggs kept at 27°C. [80·6°F.] did not, and the maximum percentage of non-diapausing larvae (45·7) developed from eggs kept at 31°C. There was some indication that fewer larvae entered diapause when the eggs were kept in the dark. The duration of the larval stage of individuals that did not enter diapause appeared to be unaffected by conditions during the egg stage; the fourth instar and, to a less extent, the second and third instar, lasted longer among larvae that diapaused than among those that did not. The author concludes that, although low temperature during the egg stage may not be the only factor determining diapause, only two generations will develop in areas where the second-generation eggs are exposed to temperatures below 27°C.

KUWAYAMA (S.). **The Rice Leaf-miner: some Observations on its Ecology and Experiments along the Control Measures**, pp. 662-671, 3 figs., 14 refs. The author points out that the correct name for the rice leaf-miner recorded in Japan as *Oscinis oryzella* Mats. [17 344; 20 542; 27 225; 28 263] or *Agromyza oryzella* [29 98] is *Agromyza oryzae* (Munakata). It was described by Munakata as *Oscinis oryzae* in 1910, and although he attributed the name to Matsumura, it was not described by the latter until 1915, when he called it *O. oryzella*. It is not known to occur outside Japan, but Hendel described a rice leaf-miner possibly identical with it from the Soviet Far East (Ussuri) in

1931 as *Agromyza oryzae* [his material having been collected by Engel'hardt (16 41)]. In Japan, it is confined to the north temperate region of Hokkaido and Honshu between latitudes 36.5 and 44°N. and is the most important pest of rice in many places, especially where the growing period of the plants is short. Studies in Hokkaido begun in 1941 showed that there are three generations a year, the winter being passed by the pupae. Adults emerge in late May or June, in late June or July, and in early August, respectively. The eggs are laid singly in the upper surface of the leaves, and the larvae hatch in six days and mine downwards in the leaf. Larval development occupies 10-14 days, and the pupal stage, which is passed on either surface of the leaf, on the sheath, or sometimes in the mine, 7-18 days; a few pupae enter diapause and hibernate. Second generation larvae are abundant by mid-July and pupate at the end of the month. Most do not complete their development until the following spring, but a few adults emerge in early August. Third-generation larvae damage late-sown rice in August-September or feed on wild *Zizania latifolia* and are not of economic importance. The percentages of pupae that enter diapause by given dates and the date at which diapausing pupae first appear vary from year to year; indications were obtained that the percentage increases with temperature and that there is a sudden increase when the mean temperature exceeds 20°C. [68°F.].

Recommended control measures comprise the collection of overwintered puparia, the eradication of *Z. latifolia*, and the use of contact sprays. In laboratory tests, a spray containing 2.2 lb. pyrethrum emulsion concentrate (1.5 per cent. pyrethrins) per 100 gals. water was the most effective tested against the adults and eggs, but 2.6 lb. derris emulsion concentrate (2 per cent. rotenone) and, to a less extent, 1 lb. derris powder (5 per cent. rotenone) per 100 gals., were superior to it against the larvae; the derris sprays were moderately effective against the eggs and adults. Nicotine sulphate was the least effective. In field experiments in 1941-43 with similar sprays, derris proved the most satisfactory, especially the emulsion, which gave an average larval mortality of 51.6 per cent. and apparently repelled the adults. In a further laboratory test, a spray containing 10 lb. of the derris emulsion concentrate per 100 gals. gave complete mortality of the larvae, but since one containing 3 lb. killed 84.7 per cent., 2.5 lb. is probably adequate in practice.

KATO (M.). **The ecological Investigation concerning the environmental climatic Condition of the Rice Leaf-miner, *Agromyza oryzella* Matsumura**, pp. 654-656. In some parts of Honshu (Japan), such as Fujishima, the first-generation larvae of *Agromyza oryzae* (Munakata) (*oryzella* (Mats.)), which attack rice in the seed-beds, are the most injurious, whereas in others such as Akita, it is the second-generation larvae, which attack the plants in the fields, that cause the most damage. In experiments, the optimum temperature range was 20-25°C. [68-77°F.] for adults and larvae of both generations that were collected in Akita, where the average numbers of second-generation larvae per clump of rice and the percentage larval mortality were 25-30 and 24, respectively, and in Fujishima, where the corresponding figures were about 20 and 52 and the general temperature was higher than in Akita, though temperatures and relative humidities during the emergence period of the adults were similar at both places. Measurements by means of a thermocouple showed that the temperature of the leaf mesophyll was about 1°C. [1.8°F.] higher than that of the leaf surface and the air between 10 a.m. and 4 p.m. in Akita and about 2°C. [3.6°F.] higher during the same period in Fujishima. During the first generation, the air temperature about the plants varied from 13 to 24°C. [55.4 to 75.2°F.] with a mode of 14-22°C. [57.2-71.6°F.] in Akita and from 8 to 28°C. [46.4-82.4°F.] with a mode of 14-24°C. in Fujishima. The corresponding ranges and modes during the second generation were 18-27°C. [64.4-80.6°F.]

and 19–26°C. [66.2–78.8°F.] in Akita and 19–32°C. [66.2–89.6°F.] and 20–26°C. in Fujishima. Differences in activity at the two places are thus probably the result of temperature.

YUASA (H.). **Resistance in Rice Plant to Rice Stem Maggot**, pp. 716–720, 1 fig. *Chlorops oryzae* Mats. [24 482, 695] passes through two generations a year and damages rice only in the field over most of Japan, but passes through three generations and damages both seedling and planted rice in the south-west; in both areas, the last generation develops on wild grasses. Observations on rice in a two-brooded area showed that there are distinct varietal differences in susceptibility, that glutinous and non-glutinous rice are equally susceptible, and that upland rice is in general more susceptible than irrigated rice. The percentage of injured ears was reduced by artificially retarding the heading period of mid-season varieties and by advancing that of early ones. The heading period can be altered by adjusting the sowing or transplanting dates or by the application of fertilisers. There is a high positive correlation between the percentage of infested stems and injured ears, and an inverse one between the total number of stems present and the percentage of infested ones. Since early varieties in general produce fewer stems than later ones, the percentage of infested stems on them is usually high. No varietal differences were found in the mortality among young larvae feeding in the leaf sheaths, but there was a definite correlation between mortality while the larvae were feeding in the leaves prior to attacking the young ears and subsequent ear infestation. Ears produced by shoots with leaf sheaths containing dead larvae appear healthy, but observations showed that they are short, the numbers of rachillae and grains in them and consequently their weight are all reduced, and the heading period is delayed; the total numbers of grains in ears on the main stem and on tillers of infested plants of one variety were reduced by about 10 and 30 per cent., respectively. Mortality among young larvae is high in late varieties, probably because the eggs are laid on the lower leaves, and since these varieties produce more leaves than early ones, the larvae have farther to travel to reach the young ears. Damage, which comprises white patches and feeding holes on the leaves, usually first appears on the leaf next above that on which the eggs were laid, but in very susceptible varieties, the three leaves next above it are all damaged; in general, white patches are more numerous than holes on resistant varieties, with the reverse on susceptible ones. Infested plants usually tend to produce more but lighter ears than uninfested ones, but the ears produced by infested plants of one widely grown variety increased both in weight and number. Populations of *C. oryzae* are greatly influenced by environmental factors, and the extent to which any one variety is damaged varies from place to place.

VAYSSIÈRE (P.) & GALLAND (H.). **Sur trois insectes d'importance économique encore peu connues en Afrique française**, pp. 699–701, 11 refs. Notes are given from the literature on the bionomics and control of the Cecidomyiid, *Pachydiplosis oryzae* (Wood-Mason), and *Laphygma exempta* (Wlk.), which were recorded damaging rice in the French Sudan for the first time in 1947. It was stated by Vincent, who observed them, that *P. oryzae* infests young, weak, chlorotic plants during June–September and *L. exempta* varieties of rice with thick stems during October–November. It is also recorded that larvae of the Dynastid, *Heteroligus meles* (Billb.) (*Heteronychus claudius* (Klug)) became abundant in the French Cameroons prior to 1946 and attacked plantations of coffee in damp, low-lying districts, especially in the Noun valley. Up to 90 per cent. of the young plantations were destroyed, and in 1944 larval density was nearly 28 per sq. yard in one plantation. The larvae chiefly attacked the root-collars of plants about seven months old. There appears to be one generation a year, and the adults are most abundant from the end of September until the end of October.

EL ZOHEIRY (M. S.). **The Wasp Beetle, *Chlorophorus varius* Mull. (Coleoptera—Cerambycidae), a new Pest of Grape Vines in Egypt**, pp. 727-731, 6 figs. *Chlorophorus varius* Müll. was known in Egypt as a secondary pest of peach, apricot, apple, mulberry and *Robinia* up to 1945, but in 1946, larvae of this Cerambycid were found in three-year-old trunks and two-year-old branches of grape vines of two varieties on a large plantation in Lower Egypt. A survey in the area in 1946-47 showed the beetle to be well established and widely distributed on a number of varieties, especially the two on which it was first noticed. Larvae in infested canes collected in February 1946 pupated during the last fortnight of April, and adults emerged between 5th and 25th May. In the field, adults were first captured on 25th April and continued to emerge until July. In the laboratory, the adults survived for a fortnight when given access to flowers and for $8\frac{1}{2}$ days when kept without food. Pairing occurred repeatedly during the first five days after emergence, and the first eggs were laid 3-6 days after the last mating. They were deposited singly in cracks in the bark, under the bark, and in wounds, and the larvae hatched in 7-10 days, but did not survive in the laboratory. They tunnel just below the bark in the branches and trunks, but hollow out the pith when they enter the tips of pruned canes. Larvae that attack the base of pruned canes tunnel into the stems for a distance of 2-4 ins. Infested canes are killed, and heavy infestations in the stems kill the vines. The wood of infested branches becomes yellow-white in colour, and the bark peels readily. Carbon bisulphide injected into the wood of infested canes and stems during the dormant period gave complete control of the larvae in 24 hours and did not harm the vines; similar results were obtained in four hours when infested wood was soaked with carbon bisulphide and then covered with moist soil. Benzene was equally effective, could easily be applied to the infested bases of pruned canes, and was harmless to the plants during the growing period. Both materials gave satisfactory control when used on a large scale during 1946-48. Orthodichlorobenzene gave only 75 per cent. mortality of the larvae immediately under the bark and did not kill those in the wood or in frass.

EL ZOHEIRY (M. S.). ***Leptoxyda* (*Dacus*) *longistylus* Wiedemann (Diptera : Trypanidae), a new Pest of cucurbitaceous Plants in Upper Egypt**, pp. 721-726, 15 figs. *Dacus* (*Leptoxyda*) *longistylus* Wied. has been known in Upper Egypt from *Calotropis procera* since 1917, but was found in 1947 attacking cucumber (*Cucumis sativus*), snake cucumber (*C. sativus* var. *flexuosus*), hairy cucumber (*C. melo* var. *chate*) and watermelon (*Citrullus vulgaris*) over large areas bordering the Nile; *Calotropis procera* growing among these cucurbits was heavily infested. Surveys in October 1947 and April 1948 showed that north of Aswan cucurbits were infested at only one place, where *C. procera* was not present. As a result of infestation by the Trypetid, the fruit valves of *C. procera* become dark and wrinkled, the seed floss decays and the seeds are destroyed; infested cucurbit fruits turn yellow and wither, the pulp and seeds rot, punctures covered with a dry, yellow secretion appear on the rind, and heavily infested fruits split. The adults appear in late autumn, and the females lay about 200 eggs each in about a month. The eggs are deposited singly under the skin of the fruit and hatch in a few days, and the larvae feed on the pulp and seeds for about two weeks, after which those developing in *Calotropis* pupate in the fruit and those in cucurbits in the soil. The pupal period occupies 12-17 days in spring and 8-10 in early summer. Four generations were reared during March-July 1948. A bait of wheat bran, molasses and sodium arsenite placed under plants and in shady situations in the field gave satisfactory control of the adults, provided that it was kept moist with sweetened solution. Other control measures comprised the destruction of infected cucurbit fruits, the eradication of *C. procera* and the use of a bait spray containing 1 oz. sodium fluosilicate and 2 lb. granulated sugar in 4 gals. water. In addition, the movement

of cucurbit fruits and plants from infested to uninfested zones and the sale of infested fruits were prohibited from August 1947.

EL ZOHEIRY (M. S.). *Heliothis nubigera* H.-S. (Lepidoptera—Noctuidae), a new Pest of Water-melons in Egypt, pp. 732–736, 4 figs. Watermelons cultivated in trenches in two localities in Egypt were found in April 1948 to be heavily infested by *Heliothis nubigera* H.-S. The plantations were surrounded by desert areas in which plants are abundant in years of heavy winter rainfall until they are withered by the summer heat, and the larvae were there found feeding on *Zygophyllum coccineum*, *Chenopodium album*, *Echinops spinosus*, *Panicum turgidum* and *Zilla spinosa*. By night, they migrated in large numbers to the watermelon plantations and fed on the leaves and young fruits. The larval and pupal stages and complete development lasted 16–18 days, 10–11 days and about five weeks, respectively. Pupation takes place in the soil. The second generation appeared in May, and the larvae were fully fed at the end of the month. A third generation was expected in July, but the desert plants dried up and it did not appear. Growers stated that this Noctuid becomes of importance in years following heavy winter rainfall and that there was a similar outbreak in 1945, when the area was flooded. Owing to its habit of pupating in sandy soil, which in summer becomes very hot, and its dependence on desert plants, which are present only for a limited and variable period, there is considerable natural control. Artificial measures comprised digging deep trenches round the plantations at a distance of about 60 yards to trap the migrating larvae, which were then burned, and dusting the weeds in a belt round the plantations with an arsenical in the early morning, which killed the larvae.

VAPPULA (N. A.). The Plum Borer (*Rhynchites cupreus* L.) as a Pest in Finland, pp. 695–698, 1 fig., 15 refs. *Rhynchites cupreus* (L.) has caused fairly considerable damage to apple trees in Finland during the past twenty years. The overwintered adult weevils appear in early June. Maturation feeding [cf. 22 464] has not been observed in Finland. Oviposition begins about the middle of June, when damage first becomes apparent, and continues during July or even later. The eggs are laid in first-year shoots, and the female then cuts the portion containing them at a point 2–6 ins. from the end. As a result, the growth of nursery stock and newly planted trees, which are most frequently affected, is seriously impeded. In 1944, the main shoots of nearly all of about 150 young trees were destroyed and in another orchard of 100 young trees, the first-year shoots of all were damaged. Shoot injury is occasionally reported on plum trees and more rarely on cherry or pear. Similar damage has been observed on *Sorbus aucuparia*, *S. aria*, *Crataegus* sp. and *Amelanchier canadensis*. Damage to young apple fruits appears to be less common, but has caused losses of 50–60 per cent. Plum trees are less commonly grown in Finland, and considerable losses of unripe plums due to *R. cupreus* have been reported from only one place, where in one variety they amounted to 90 per cent. Superficial feeding may also occur on larger apples, as a result of which corky patches develop on them.

WRIGHT (D. W.), GEERING (Q. A.) & DUNN (J. A.). Varietal Differences in the Susceptibility of Peas to Attack by the Pea Moth, *Laspeyresia nigricana* (Steph.).—*Bull. ent. Res.* 41 pt. 4 pp. 663–677, 5 figs., 4 refs. London, 1951.

The following is largely the authors' summary. The variations in susceptibility of different varieties of peas to attack by *Cydia* (*Laspeyresia*) *nigricana* (Steph.) were investigated in eastern England during 1946 and an attempt was made to determine and measure the factors concerned [cf. R.A.E., A 36 263]. Six varieties of peas differing widely in haulm length and earliness of maturation were used in each of two trials. In the first, in which the sowing date was

29th March, the early maturing varieties came into flower before the moths were present on the crops and suffered the lowest infestation. The later varieties were exposed to attack over a much longer period and suffered the heaviest infestations. In the second trial, in which the sowing date was 3rd May, the attack was more uniform over all varieties and the early varieties were more severely infested than in the first trial; they were exposed to attack from the beginning of flowering until harvest. An estimate of the changes in the active moth population during the flight period, based on the numbers of larvae up to 3.5 mm. in length in pod samples taken at bi-weekly intervals from a neighbouring crop, was obtained, and the varieties were compared in relation to the proportion of this population to which each had been exposed. There was a strong positive correlation between the degree of exposure and the incidence of attack on the different varieties. Infestation was also found to be influenced by the amount of cover that each variety provided; those with the densest foliage suffered the heaviest attacks. Statistical analyses showed that the two factors, exposure and plant cover, were closely associated and exerted a joint influence on subsequent infestation. Data from other trials corroborated these findings and showed that strains of peas bred to mature early suffered substantially lower infestation than did the later maturing types from which they had been bred.

STRICKLAND (A. H.). **The Entomology of Swollen Shoot of Cacao. I. The Insect Species involved, with Notes on their Biology.**—*Bull. ent. Res.* 41 pt. 4 pp. 725–748, 1 fig., 16 refs. London, 1951.

This is the first of two papers on the entomological aspects of the swollen-shoot disease of cacao in West Africa, chiefly the Gold Coast, and constitutes a review of the species that have a bearing on transmission. These include 17 mealybugs, most of which have been shown to be vectors, 75 ants, many of which are associated with them, and their natural enemies, which comprise 16 Hymenopterous parasites, two Coccinellids, a predacious Cecidomyiid, a spider and a parasitic mite, together with 18 Coccids of other groups that are not known to transmit the disease. Lists of the species are given, with notes on the identity of some of the Coccids and the taxonomy of the more important groups of ants. The paper also includes information on the bionomics of the mealybugs, some of which has already been noticed [*R.A.E.*, A 36 110; 37 86–87], and the habits and relative abundance of the ants, based on observations in the Gold Coast.

The morphology of *Pseudococcus njalensis* Laing, the chief mealybug vector, is variable, but comparison of specimens from a colony on a cacao pod, from cacao trees in different parts of West Africa, and from ant domatia in a stem of *Canthium glabriflorum* indicated that there is no justification for erecting subspecies, except possibly for the group from *Canthium*. *P. njalensis* comprised 189,267 of a total of 401,140 Coccids collected from 2,880 mature cacao trees selected at random in the Gold Coast; *P. citri* (Risso) comprised a further 1,939, and other mealybugs only 219. *Stictococcus sjöstedti* Ckll. was the most abundant of the Coccids of other groups and slightly more numerous than *P. njalensis*.

P. njalensis is ovoviviparous, and the female normally produces 30–40 viable eggs in up to 20 days. The three nymphal instars and the pre-oviposition period lasted 4–13, 3–10, 5–9 and 18–30 days, respectively, in the laboratory, and females survived for 10–14 days after oviposition was completed. Parthenogenetic reproduction occurred, but may be limited in some way, since one female survived in isolation for 65 days without ovipositing. Investigations on the food-plant preferences of *P. njalensis* in cacao plantations in the Eastern Province of the Gold Coast showed that about 17 per cent. of wild plants of eight

families and 41 per cent. of the cacao trees were infested. The mealybug was invariably associated with ants on *C. glabriflorum*, and its mean population on the latter was estimated at 10,697 per tree; *C. glabriflorum* is not considered to be of major importance as an alternative food-plant, however, as it is uncommon.

When heavily infested mature cacao trees were felled, *P. njalensis* could not be found on them after 24 days, though some examples were still present after 18 days. It left smaller trees within 11 days of felling. Infected mealybugs lose their infectivity if starved for more than 36 hours, and it was found that they could not remain infective for more than 14 days after their food-plant had been felled. There was little infestation of standing cacao trees by migration over the ground, either unaided or assisted by ants, from felled infested trees. Over 87 per cent. of the total number of *P. njalensis* collected from 1,180 infested trees were in the canopy at a height of 15–20 ft. above the ground, and 75.5 per cent. were on the young shoots. It is a forest insect and was received in collections from Sierra Leone, the Ivory Coast, Liberia, the Gold Coast and Togoland, the Western Province of Nigeria, and the British Cameroons, becoming less common from west to east. The dry area of Togoland may serve as a barrier to its eastward spread, since there is little cacao there; furthermore, cacao in Western Nigeria, unlike that in the Gold Coast, is grown without forest shade. Its parasites comprise 13 species of Hymenoptera, of which those that have been specifically identified comprise, in addition to some already noticed [36 111], *Anagyrus pullus* Comp., which is the commonest, *A. beneficans* Comp., *Leptomastix bifasciatus* Comp., *Tropidophryne melvillei* Comp., and *Chiloneurus carinatus* Comp., which may be a hyperparasite; predators include larvae of the Coccinellids, *Platynaspis higginsii* Crotch and *Scymnus* sp.

Of the other mealybugs, *Paraputo ritchiei* Laing is virtually restricted to sterculiaceae plants, principally *Cola chlamydantha* and *C. cordifolia*, both of which are alternative hosts for the virus [38 378], and has been shown to be infective when feeding on diseased *Cola* in the Western Province of the Gold Coast. *Formicococcus tafoensis* Strickland appears to prefer *Ceiba pentandra* to cacao, and *Pseudococcus bukobensis* Laing, which oviposits and feeds readily on *Trema guineensis*, feeds on cacao but rarely oviposits on it. *P. adonidum* (L.) (*longispinus* (Targ.)) and *Ferrisia virgata* (Ckll.) are sometimes abundant on ornamental plants (such as *Aristolochia*) and *Leucaena*, respectively, but are never so numerous on cacao. *P. citri* has no strong food-plant preferences. Unlike *P. njalensis*, the other mealybugs became progressively more numerous in collections towards the east of West Africa.

Although many of the ants tend the mealybugs, *Macromischoides aculeatus* (Mayr) is predacious and *Oecophylla longinoda* (Latr.), which is the commonest ant on cacao in the Gold Coast, is associated with Coccids of the genus *Stictococcus* and attacks the mealybug-tending species. These two ants may therefore limit the spread of the mealybugs and the virus.

It is concluded that three distinct but complementary ecological niches are involved, comprising the association between the mealybug vectors and the ants that tend them, which is the most important, the association between *Paraputo ritchiei* and *Formicococcus tafoensis* and the wild forest-tree hosts of the virus, and the negative association between the mealybug-tending ants and the two that attack them.

WOODROFFE (G. E.). **A Life-history Study of *Endrosis lactella* (Schiff.) (Lep. Oecophoridae).**—*Bull. ent. Res.* 41 pt. 4 pp. 749–760, 3 pls., 2 graphs, 15 refs. London, 1951.

The following is substantially the author's summary of laboratory investigations on the bionomics of *Endrosis lactella* (Schiff.), which is a minor pest of stored products, especially grain and seeds, in Britain, and occurs frequently

in association with *Hofmannophila pseudospretella* (Staint.) [*R.A.E.*, A 39 80]. The incubation period of the eggs of *E. lactella* varied between 42 days at 10°C. [50°F.] and 6 days at 26°C. [78.8°F.] and was almost unaffected by changes in relative humidity. Survival of eggs was low at high temperatures and low humidities, and the mean survival from complete batches of eggs at 70 per cent. relative humidity and 25°C. [77°F.] was 44 per cent. The highest survival recorded was 81 per cent. On a diet of middlings, the larval stage lasted 133 days at 90 per cent. humidity and 10°C., and 38 days at 90 per cent. and 25°C. No adults were reared when the larvae were kept at relative humidities below 80 per cent. There were seven instars at 25°C. and 90 per cent. humidity. When the larvae were reared on various foodstuffs at 90 per cent. humidity and 20°C. [68°F.], the duration of the larval stage ranged from 40 days on dead moths to 109 days on macaroni. Survival to the adult stage varied between 75 per cent. on whole wheat and 20 per cent. on groundnuts. The pupal stage lasted 58 days at 10°C. and 10.4 days at 25°C., and was of approximately the same duration at all humidities. The time required for complete development from egg to adult at 90 per cent. humidity was 235 days at 10°C. and 62 days at 25°C. There was a significant correlation between the weight of a female moth at emergence and the number of eggs laid. Egg output was lower at 25°C. than at 15°C. [59°F.], and was not significantly affected by relative humidity, but was increased by the provision of drinking water. Weights of females varied from 2.9 mg. to 9.4 mg. and egg output from 14 to 231 eggs. The ratio of males to females in the dried grass culture from which the experimental insects were obtained was found to be 1 : 23. Adult survival could not be correlated with weight in all experiments, but, in the case of fertilised females, was dependent upon temperature, humidity and availability of drinking water. The mean survival periods in days for fertilised females were 3 at 30 per cent. humidity and 25°C. ; 5 at 90 per cent. and 25°C. ; 9.1 at 90 per cent. and 15°C. ; and 8.9 at 70 per cent. and 25°C. when drinking water was provided. Males that had paired survived for only 2-4 days at 70 per cent. humidity and 25°C. The only important predator in the cultures was the mite, *Cheyletus eruditus* (Schr.), which attacked the young larvae.

DEAN (R. W.). **Evaluation of some new Insecticides for Apple Maggot Control.**—*J. econ. Ent.* 44 no. 2 pp. 147-153, 1 ref. Menasha, Wis., 1951.

Further experiments were carried out in New York in 1947-50 on the control of *Rhagoletis pomonella* (Walsh) [*cf.* *R.A.E.*, A 36 324, etc.]. Laboratory tests in which the adults were exposed to films obtained from sprays of the different materials as wettable powders showed that parathion, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] were outstanding in their toxicity and speed of action. Toxaphene, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], ethyl p-nitrophenyl thionobenzene phosphonate (EPN), 1,1-di(p-ethylphenyl)-2,2-dichloroethane (Q-137) and a 1 : 2 mixture of 2-nitro-1,1-bis(p-chlorophenyl)propane (CS-645A) and 2-nitro-1,1-bis(p-chlorophenyl)butane (CS-674A) were also very toxic, but were slower in action. Chlordan was less toxic, except at higher concentrations, and required a relatively long time to become effective, though repeated short periods of exposure appeared to cause death eventually ; this compound showed definite vapour toxicity. Fluoro-DDT (DFDT) was more toxic and more rapid in action than DDT, which was not highly effective. CS-645A and CS-674A, tested separately, caused the most rapid knockdown. BHC (benzene hexachloride), methyl-DDT (ditolyl trichloroethane), DDD (TDE) [dichlorodiphenyldichloroethane] and methoxy-DDT (methoxychlor) appeared to be less toxic than DDT

when the flies were in contact with the spray films for brief periods only and were little faster in causing knockdown when the flies were exposed to them continuously. All materials except methyl-DDT caused more rapid kill than DDT when the periods of exposure were controlled.

In orchard tests, fairly isolated blocks of apple trees and adjacent hedges, woods and other high vegetation were treated with various sprays applied with standard orchard equipment. The quantities given are per 100 U.S. gals. spray. Sprays of 2 lb. 50 per cent. chlordan, applied on 23rd June, 5th and 16th July and 4th August 1947, 2.5 lb. 40 per cent. toxaphene with 5-6 lb. wettable sulphur paste on 30th June and 9th July 1948 followed by 4 lb. 25 per cent. toxaphene on 20th July 1948, 2 lb. 15 per cent. parathion on 27th June and 7th, 18th and 28th July 1949, and 2 lb. 25 per cent. dieldrin with 4-5 lb. wettable sulphur on 26th June and 19th July and without it on 11th August 1950 did not prevent high percentages of infested fruits. A spray of 3 lb. lead arsenate, 1 lb. 15 per cent. parathion and 4 lb. wettable sulphur was effective when applied on 28th June and 19th July 1949, but completely ineffective when used on 26th June, 19th July and 9th August 1950. A wettable powder containing 50 per cent. of the mixture of CS-645A and CS-674A used at 2 lb. with 4-5 lb. wettable sulphur and a wetting agent on 27th June, 7th, 17th and 27th July and 8th August 1950 gave good control of a moderate infestation but caused fruit injury. A spray containing 2 lb. 50 per cent. DDD, applied on 27th June, 8th and 20th July and 4th August 1949, and one of 2 lb. 50 per cent. methoxy-DDT with 4-5 lb. wettable sulphur, applied on 26th June, 6th, 17th and 27th July and 8th August 1950, both gave adequate protection against initially high infestations. Lack of persistent toxicity appeared to be the reason for the failure in the orchard of some insecticides that were highly effective in the laboratory.

GRIFFITHS (J. T.), STEARNS jr. (C. R.) & THOMPSON (W. L.). **Parathion Hazards encountered spraying *Citrus* in Florida.**—*J. econ. Ent.* **44** no. 2 pp. 160-163, 1 ref. Menasha, Wis., 1951.

The following is substantially the authors' summary. Probably over a thousand tons of 15 per cent. wettable parathion were used on *Citrus* in Florida during 1950. No deaths were recorded, but 48 cases of supposed parathion poisoning were reported, and 25 of these were assumed to be authentic. Enquiry into the circumstances showed that 11 men were using hand spray guns, five were mixing materials in the spray tank, five were using hand guns and mixing materials and three were drivers of tractors pulling Speedsprayers. In special studies, the weights of parathion handled per day were not correlated with either the amount of parathion per respirator filter disk or changes in red blood cell cholinesterase. Prolonged exposure appeared to be a major contributing factor to the incidence of parathion poisoning. It was concluded that skin absorption was the primary cause, that men spraying in *Citrus* groves in Florida should not be exposed to parathion sprays for more than a week at a time and that an interval of at least a week should occur between exposure periods.

WEAVER (C. R.). **Meadow Spittlebug Control with low and high Volume Insecticide Applications.**—*J. econ. Ent.* **44** no. 2 pp. 163-166, 5 refs. Menasha, Wis., 1951.

Further tests of sprays for the control of nymphs of *Philaenus leucophthalmus* (L.) were made on mixed meadow crops in Ohio in 1950 [cf. *R.A.E.*, A **38** 422]. BHC (benzene hexachloride) was applied at 0.2 lb. γ isomer, toxaphene at 1.5 lb., chlordan at 1 lb. and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 0.25 lb. per acre. They

were used as wettable powders or emulsifiable concentrates in 100 U.S. gals. spray per acre applied at a pressure of 150 lb. per sq. in. and as emulsifiable concentrates in 37 or 9 U.S. gals. per acre at a pressure of 30 lb. per sq. in.

Both BHC and toxaphene gave excellent control on crops 6-8 ins. high when applied on 13th-15th May in 9 or 100 U.S. gals. spray. Chlordan in 9 or 100 U.S. gals. and aldrin in 100 U.S. gals. gave less control, but reduced populations sufficiently to prevent serious losses of yield. BHC applied in 100 U.S. gals. spray on 27th April, when the plants were less than 4 ins. high and the nymphs first appeared, had sufficient residual action to give 98 per cent. control of the nymphs, including those that hatched after treatment; when applied to foliage 12-18 ins. high on 24th May, it gave excellent control in 37 or 100 U.S. gals. spray, but was less effective in 9 U.S. gals. All treatments gave increases in yield, and rain immediately following applications of BHC, toxaphene and chlordan apparently did not reduce their efficacy.

DICKSON (R. C.), FLOCK (R. A.) & JOHNSON (M. McD.). **Insect Transmission of Citrus Quick-decline Virus.**—*J. econ. Ent.* **44** no. 2 pp. 172-176, 5 refs. Menasha, Wis., 1951.

The disease of *Citrus* in southern California known as quick-decline is one of a group of similar virus diseases that occur in various countries and are particularly destructive to sweet orange growing on sour-orange rootstocks [cf. *R.A.E.*, A **37** 319]. The form known in Brazil as tristeza has been shown to be transmitted by *Aphis citricidus* (Kirk.) [cf. **37** 319; **39** 136], and this finding has been confirmed in Argentina, South Africa and Australia. *A. citricidus* is widely distributed throughout the world but has not been taken in the United States, so that some other vector must be responsible for transmission in California.

Surveys made in 1945-49 by means of adhesive traps hung in *Citrus* trees showed that 318 species of sucking insects occurred on *Citrus* in southern California, and 310 species of insects and two species of Tetranychid mites were tested for transmission of the virus. The different species were tested roughly in the proportion in which they were caught, and were fed on infected trees, usually for a week or more, and then transferred to test trees for 2-8 weeks. Symptoms were obtained on 13 test trees on which *Aphis gossypii* Glov. was the only insect, on three on which it was accompanied by various Membracids and on two on which Membracids occurred alone. It is concluded that *A. gossypii* is the vector, though its efficiency is not high, only two transmissions being obtained with about 3,200 insects in the first 20 tests. The evidence regarding the Membracids is considered inconclusive.

Surveys of the Aphids breeding on *Citrus* in southern and central California in March and April 1950 showed that *A. gossypii* was abundant in areas in which the disease had spread rapidly and generally scarce in those in which it had spread slowly. The Aphids infest the immature leaves, twigs and buds of the trees, but not the mature leaves, so that high populations are associated with flushes of growth.

CHAMBERLAIN (W. F.) & HOSKINS (W. M.). **The Inhibition of Cholinesterase in the American Roach by organic Insecticides and related Phosphorus-containing Compounds.**—*J. econ. Ent.* **44** no. 2 pp. 177-191, 1 graph, 27 refs. Menasha, Wis., 1951.

The following is largely based on the authors' summary. A study was made of the cholinesterase system in adult males of *Periplaneta americana* (L.) and its sensitivity to organic phosphorus compounds, in an attempt to determine details of their toxic effects [cf. *R.A.E.*, A **38** 317, etc.]. The chemicals were

administered by injection of an aqueous solution or an alcohol or acetone solution diluted with water between the fourth and fifth abdominal sternites or in a few cases by topical application in water or an organic solvent to the dorsal abdominal surface beneath the wings, and the cholinesterase activity of the ventral nerve cord of treated and untreated cockroaches was compared to find the extent of inhibition due to the different compounds. Inhibition was also determined in breis of nerve cords removed from normal insects and exposed to the chemicals. Untreated insects showed an average of 0.679 micromol acetylcholine split per mg. tissue per hour as measured by the rate of formation of acetic acid in the presence of a brei made from the nerve cord, when the substrate concentration was 0.25 per cent. This is higher than the optimum substrate concentration of 0.11 per cent. or 0.005 M, but the change in rate is only a few per cent. Activity of the fat-body, muscle or testes is approximately 0.01 micromol per mg. per hour.

Toxic effects appeared when inhibition *in vivo* reached about 85 per cent. Of the 18 compounds tested, parathion and paraoxon [diethyl p-nitrophenyl phosphate] were the most active inhibitors when tested *in vivo*. When the amounts of injected chemicals were calculated as concentration in body fluid, there was good agreement between extent of inhibition *in vivo* and *in vitro* except in the case of parathion, which was much less effective *in vitro*. Attempts to increase the effect of parathion *in vitro* failed when it was incubated for several hours with insect blood or various body organs and succeeded only when an intact ventral nerve cord was present, and it is suggested that parathion is changed to the more reactive paraoxon whenever it makes contact with an intact nerve cord and thus is more reactive as a cholinesterase inhibitor *in vivo* than *in vitro*. *In vitro* inhibition increased rapidly immediately after nerve-cord brei and inhibitor were brought together and continued to increase slowly for several hours with most of the compounds studied. The most active compounds contained the group $(RO)_2P(O \text{ or } S)X$, in which R is an alkyl radical and X may be a phenoxy group or chlorine. No activity was found with three phosphonates and two anilido phosphates tried. The thiophosphates were slower than the phosphates in causing signs of toxic action, but not usually less toxic ultimately.

The cholinesterase in the ventral nerve cord of *P. americana* is less active and less sensitive to chemicals that inhibit its activity than that from honey-bee brain [cf. 39 174].

HUCKETT (H. C.). **Tests of Acaricides for Control of the Two-spotted Spider Mite on Lima Beans on Long Island.**—*J. econ. Ent.* 44 no. 2 pp. 192–196, 2 refs. Menasha, Wis., 1951.

Sprays and dusts for the control of the Mexican bean beetle [*Epilachna varivestis* Muls.] and the mite, *Tetranychus bimaculatus* Harvey, on lima beans were tested on Long Island in 1950. Sprays of systemic insecticides, which comprised schradan (octamethyl pyrophosphoramidate) and Compound E-1059 (an organophosphorus compound of unspecified composition), were applied on 1st and 21st July at an average rate of 164 U.S. gals. per acre per application, other sprays on 5th and 21st July and 11th August at 185 U.S. gals. per acre and dusts on 7th and 22nd July and 11th August at 65 lb. per acre. Bordeaux mixture (4 : 4 : 50) was applied four times as a fungicide. Estimates were made of foliage injury due to *E. varivestis* and of foliage and pod injury due to the mite. All spray quantities are given per 100 U.S. gals. water.

Sprays of 0.5–1 lb. of a wettable powder containing about 30 per cent. EPN-300 (ethyl p-nitrophenyl thionobenzenephosphonate), 1 U.S. pint emulsion concentrate containing 30 per cent. Compound E-838 (diethoxy

thiophosphoric acid ester of 7-hydroxy-4-methyl coumarin), 2-3 U.S. pints 32 per cent. Compound E-1059, 1 U.S. pint emulsion concentrate containing 25 per cent. parathion or 0.5-1 lb. 25 per cent. wettable parathion reduced feeding by *E. varivestis* to a minimum, whereas those containing 0.5-1 U.S. pint 20 per cent. emulsion concentrate of TEPP (tetraethyl pyrophosphate), 1.5 lb. 15 per cent. wettable 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methyl-ethyl sulphite or 1 U.S. pint 30 per cent. emulsion concentrate of dialkyl nitroaryl thiophosphates gave smaller reductions, and 1-2 lb. 50 per cent. wettable p-chlorophenyl p-chlorobenzenesulphonate and 1-2 U.S. pints 63 per cent. schradan were ineffective. The sprays of EPN-300, Compound E-1059, the chlorobenzenesulphonate and the sulphite were the most effective against the mite, as indicated by both criteria, and there were also large increases in the yield of uninjured pods in plots sprayed with the parathion suspension at the higher dosage, the parathion emulsion, schradan or the dialkyl nitroaryl thiophosphates.

Of the dusts, 0.5-1 per cent. parathion was the best against both pests, 1 per cent. EPN-300 was less effective against the mite than the sprays of the same material, but slightly more so against the beetle, and 1.5 per cent. of the dimethyl analogue of parathion was less effective than 1 per cent. parathion. Dusts of 10 per cent. of the chlorobenzenesulphonate were effective against the mite on leaves and pods, but not against the beetle, and 1 per cent. TEPP was ineffective against both. The failure of TEPP in these experiments may have been due to the small number of applications, to the long intervals between them, and, particularly in the case of the dust, to heavy dew on the foliage at the times of treatment.

Spray suspensions of chlorophenyl chlorobenzenesulphonate and the dust containing the dimethyl analogue of parathion damaged the foliage, but the sulphonate dust was relatively harmless.

LANGFORD (G. S.), SQUIRES (D. W.) & DOZIER (B. H.). **The relative Efficiency of some Insecticides for Japanese Beetle Control.**—*J. econ. Ent.* **44** no. 2 pp. 197-201, 5 refs. Menasha, Wis., 1951.

The following is largely based on the authors' summary. Laboratory and field experiments were carried out in Maryland to compare aldrin [1,2,3,4,10,10 - hexachloro-1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene], chlordan, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octa-hydro-1,4,5,8-diendomethanonaphthalene], BHC (benzene hexachloride), lindane [at least 99 per cent. γ BHC], methoxy-DDT (methoxychlor), DDD (TDE) [dichlorodiphenyldichloroethane], toxaphene and parathion with DDT for the control of adults of *Popillia japonica* Newm. [*cf. R.A.E.*, A **34** 245 ; **36** 339]. No attempt was made to establish recommended dosages of the various insecticides, as these vary with different conditions. All materials in both emulsion and wettable-powder sprays were effective in killing the beetles and protecting the plants in both field and laboratory tests. In the laboratory, aldrin, chlordan, methoxy-DDT, DDD, dieldrin and toxaphene all gave mortalities that compared favourably with those from DDT at the same dosages, whether the beetles were sprayed directly or exposed to dried spray residues. Sprays containing 0.0014 lb. technical parathion or lindane per 100 U.S. gals. gave complete knockdown and kills of 98-100 per cent. in 24 hours. The initial knockdown from DDT, methoxy-DDT, lindane, parathion and DDD was much faster than that from aldrin, chlordan, dieldrin or toxaphene. In the field tests, sprays containing 0.3 lb. technical parathion or 0.1 lb. γ BHC (from total BHC or lindane) per 100 U.S. gals. water freed the plants of beetles and gave satisfactory control.

LANGE jr. (W. H.), CARLSON (E. C.) & CORRIN (W. R.). **Seed Treatments for Control of the Seed-corn Maggot in northern California.**—*J. econ. Ent.* **44** no. 2 pp. 202–208, 6 refs. Menasha, Wis., 1951.

The following is based on the authors' summary. The results are given of tests against *Hylemyia cilicrura* (Rond.) on large lima beans in the Santa Clara Valley of northern California, by means of treatments applied to the seed. The materials tested were lindane [at least 99 per cent. γ benzene hexachloride], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and chlordan. Commercial treatment with a dry or slurry mixture containing 0.33 oz. 75 per cent. lindane or 1 oz. 25 per cent. lindane per 100 lb. beans, with a suitable fungicide such as tetrachloro-parabenzquinone or tetramethyl thiuramdisulphide, gave good control of wireworms and *H. cilicrura*; about 20,000 lb. large lima beans were treated in 1949 and 245,700 lb. in 1950, with no observable adverse effects.

In experimental trials, the seed was treated with a slurry or was dusted with insecticide and then sprayed with 0.5 per cent. of its weight of water containing an adhesive. In the laboratory, 40 per cent. chlordan, 25 per cent. aldrin and 25 per cent. dieldrin, applied at 0.25 per cent. by weight of seed, had no effect on total emergence, mean emergence period or seedling weight of seed with 87 per cent. germination, but 25 per cent. aldrin at 0.125 per cent. by weight of seed caused a slight though significant delay in emergence of seed with 75 per cent. germination. In field tests with 25 per cent. aldrin, 25 per cent. dieldrin and 40 per cent. chlordan applied at 2 oz. per 100 lb. seed, the first two appeared to cause a delay in germination in 1949, but these results were not substantiated in 1950 and were attributed in part to the vigour of the seed used. In further tests in 1950, 75 per cent. lindane at 0.33 oz. and 25 per cent. aldrin or dieldrin at 1 oz. per 100 lb. seed, with fungicides, caused no delay in seedling emergence, a fair to excellent reduction in injury due to *H. cilicrura* and an increase in the number of normal plants.

Although the seed treatments are economical, effective and relatively safe in the area in which these experiments were made, they should not be used in other places without preliminary tests, as some differences due to locality were indicated.

ENGLISH (L. L.). **Sodium Selenate Soil Treatments for Chrysanthemum and Carnation Pests.**—*J. econ. Ent.* **44** no. 2 pp. 208–215, 2 figs., 9 refs. Menasha, Wis., 1951.

In the experiments described, which were begun in Illinois in 1946, sodium selenate was applied to soil in greenhouses in which several varieties of chrysanthemum and carnation were grown in order to observe its effect on the growth and production of flowers and on pest control.

In a preliminary test in 1946, treatment of chrysanthemums with 250 mg. sodium selenate per sq. ft., dissolved in water and applied uniformly to the soil on 10th August when the plants were well established, or with 125, 62.5 or 31.25 mg. on 10th August, 12th September and 10th October prevented attack by a heavy population of *Rhopalosiphum rufomaculatum* (Wils.) and a light one of mites, but the two heaviest dosages caused visible stunting. In 1947, chrysanthemums of three other varieties were kept almost completely free of Aphids, mealybugs (probably *Phenacoccus gossypii* Tns. & Ckll.) and mites by treatment of the soil with sodium selenate once, on 15th August, at 250 mg. per sq. ft., or twice, on 15th August and 15th October, at 125, 62.5 or 31.25 mg. per sq. ft. Neither the flower production nor the plant length of the two earlier maturing varieties was affected by the treatments, but those of the

later one appeared to be adversely affected by the single heavy treatment. On another three varieties of chrysanthemum grown in soil treated with 250 mg. sodium selenate on 14th July or with the other three rates on 14th July and 13th September, excellent control of Aphids and mealybugs was obtained in all cases, and the stunting caused by the single heavy application was so slight that it would probably be of no commercial importance; the flowers were not damaged by any of the treatments.

When carnations of three varieties were grown in soil treated with 250 mg. sodium selenate per sq. ft. every six months or with 62.5, 31.25 or 15.6 mg. every three months for nearly two years, all treatments gave some control of mealybugs (probably *Pseudococcus maritimus* (Ehrh.)) and the two-spotted mite [*Tetranychus bimaculatus* Harvey] and the two highest dosages gave satisfactory control for over a year, but after that, only two applications a year of 250 mg. per sq. ft. resulted in essentially pest-free plants of all three varieties. Flower production was substantially reduced on infested plots, but unaffected by treatment with sodium selenate. However, the higher dosages caused rather severe stunting, and all but the lowest shortened the stalks.

ROCKWOOD (L. P.). **Some hyphomycetous Fungi found on Insects in the Pacific Northwest.**—*J. econ. Ent.* **44** no. 2 pp. 215-217, 8 refs. Menasha, Wis., 1951.

The author records observations on a number of species of fungi found attacking insects in the Pacific Northwest of the United States and gives the results of comparative experiments on the effect of different fungi growing on adults of *Diabrotica undecimpunctata* Mannh. and on other fungi infecting insects.

BRONSON (T. E.) & RUST (R. E.). **Mist Sprays for Control of certain Truck Crop Insects.**—*J. econ. Ent.* **44** no. 2 pp. 218-220, 1 fig., 1 ref. Menasha, Wis., 1951.

During 1947-49, low-volume concentrated sprays were applied as mists to various vegetable crops in Wisconsin. In 1947-48, an improvised mist blower was used, which did not provide sufficient air volume or air velocity to break up and distribute the spray adequately, but in 1949, an improved form, similar to one already described [*cf. R.A.E., A* **39** 253], but stated to have an 18-inch radial blower fan driven at 2,200 revolutions per minute by a 20 horse-power motor, was employed. All mist sprays were applied at 10 U.S. gals. per acre, except on potato in 1949, when the rate was 12 U.S. gals. They were compared with dilute sprays applied at 100-120 U.S. gals. per acre with a conventional four-row tractor-powered sprayer against *Empoasca fabae* (Harr.) and *Epitrix cucumeris* (Harr.) on potato in all three years and against *Pieris rapae* (L.), *Trichoplusia ni* (Hb.) and *Plutella maculipennis* (Curt.) on cabbage in 1948 and 1949; in these tests DDT was used in a wettable powder and was applied at 0.5-2 lb. per acre in the mist and at 0.5-1 lb. per acre in the conventional spray. On potato, it was used with tribasic copper sulphate as a fungicide, and when the same amount of DDT was applied per acre, the two methods of application gave similar results against each insect. Some clogging of the nozzle of the mist blower was probably caused by the fungicide as none occurred in other tests in which wettable DDT was used alone. Sprays applied by the two methods also gave equally good control of the caterpillars on cabbage; the mist spray was slower in action than the conventional one, but appeared somewhat more effective against larvae of *Pieris rapae* that had burrowed into the developing head by the time of treatment. Mist sprays were also tested against *Thrips tabaci* (Lind.) on onion. In 1948, DDT at

1 lb. per acre as a wettable powder or in a methylated-naphthalene emulsion gave highly effective control, and in 1949, DDT at 1 lb. per acre in xylene emulsion and parathion at 0.25 lb. per acre in a wettable powder both proved very effective.

NEISWANDER (C. R.). **Duration of the Effectiveness of Lead Arsenate applied to Turf for White Grub Control.**—*J. econ. Ent.* **44** no. 2 pp. 221–224, 1 graph, 1 ref. Menasha, Wis., 1951.

White grubs (larvae of *Cyclocephala borealis* Arr. and several species of *Lachnosterna* (*Phyllophaga*)) have injured turf in Ohio, particularly in the east, for many years, and an experiment on their control with lead arsenate was begun in 1935. The test area was cultivated, levelled and divided into plots, and 0, 5, 10, 20 or 30 lb. lead arsenate per 1,000 sq. ft. surface was broadcast and mixed with the upper soil by raking. The entire area was then sown with a mixture of grasses and clover, which eventually formed a fairly uniform sod, and this was clipped regularly in accordance with the usual lawn practice. After 1935, no materials were added, and the only disturbances were due to the occasional sampling for grub population and arsenic content.

During 1936–50, grubs were sufficiently abundant to justify taking records in nine years. As examples of the two genera frequently occurred together and responded similarly to the arsenical, they are considered together. In 1937, all lead-arsenate treatments were highly effective, with no differences between them, but in 1943, the 5 lb. dosage reduced the grub population by only 50 per cent., as compared with no treatment, and only the 30 lb. dosage reduced it by more than 90 per cent. Grouping the results by successive periods of five years showed that only the 30 lb. dosage maintained its effectiveness throughout all three periods; the others were effective throughout the first period, but showed a gradual decline in value during the second. Soil analyses showed that there was a marked and progressive decrease in arsenic content in all the treated plots over the total period of investigation.

WALLACE (P. P.). **Octamethylpyrophosphoramidate.**—*J. econ. Ent.* **44** no. 2 pp. 224–228, 2 graphs, 7 refs. Menasha, Wis., 1951.

An account is given of experiments to determine the absorption and translocation of schradan (octamethyl pyrophosphoramidate) [*cf. R.A.E.*, A **39** 166] in bean plants by observing the degree of mortality of the mite, *Tetranychus bimaculatus* Harvey, on the leaves. The sample used was of a high degree of purity. In the first tests, the cut stems of young bean plants were kept in tap water for 24 hours, in weighed quantities of solutions of the chemical for three days and then again in tap water for five days, during which mites were exposed on them. The rate of uptake of the solutions and the activity and feeding of the mites varied with light, temperature, humidity, air movement and other environmental factors. The weight of chemical absorbed by the plants was assumed to be in direct proportion to the weight of solution taken up, and statistical analysis of the results showed that 20 mmg. schradan per gm. plant gave 95 per cent. kill of mites in the five days.

To measure the absorption by the foliage, the two primary leaves of young cut plants were dipped in various solutions of schradan, and the weight of solution deposited on each plant was noted. The plants were then kept in tap water for three days, after which mites were transferred to them and exposed for five days. A neutral surface active agent of the alkylaryl-sodium-sulphonate type was added to the solutions to allow spreading of the film. There was good agreement between uptake of chemical by the plant and mite kill, 82 mmg. schradan per gm. plant weight being required for 95 per cent. kill.

It is concluded that absorption from the leaf surfaces occurs relatively slowly. In repeated tests, better kill did not result when the treated plants were kept for more than three days before being infested, but the kill was reduced when they were kept for only one or two days. It is believed that some absorption continued after three days and that the chemical may have been translocated to new growth and other plant parts at about the same rate as that at which it was absorbed. Volatilisation of the chemical from the leaf surfaces also appears to be an important factor. Later studies have shown that various adjuvants alter the amount of schradan deposited on the leaves and absorbed by them. When one of the primary leaves was dipped in a 0.1 per cent. water solution of schradan and removed three days later, and mites were exposed on the untreated one, the mean deposit of chemical was 105 mmg. per gm. plant weight and the average kill only 18 per cent., indicating that lateral translocation was much restricted.

Tests with potted bean plants watered with schradan solutions showed that mortality of mites placed on them varied with the development of the root system, which obviously affected absorption. When the plants were watered with the solution two days after being set in soil, kept in the treated soil for three days and then cut and infested with the mites, the results indicated that 0.16 gm. schradan per 1,000 cc. soil was required to supply the plants with sufficient to kill 95 per cent. of the mites in five days. This was equivalent to 6,500 mmg. per gm. cut plant, but it is probable that different soil types vary in capacity to fix the ions of the chemical so that part of it is unavailable to plants. Bean plants that were grown in treated soil for 16 days before being cut and infested with mites took up so much of the chemical that all mites were killed at the lowest dosage (100 ml. 0.025 per cent. solution per 500 cc. soil) within a few hours of beginning to feed. Beans that were grown for three days in soil that had been watered with schradan solution 36 days before and in which two earlier groups of bean plants had been grown in succession caused mite mortality that did not differ significantly from that on plants of the two earlier groups.

Aqueous solutions containing 0.001 or 0.02 per cent. schradan did not affect the rooting of bean cuttings maintained in them for nine days, but those containing 0.2 per cent. hindered rooting and injured the foliage. However, when the soil of potted plants was saturated with 0.2 per cent. solution, no adverse effect on roots or foliage was observed.

SMITH (F. F.) & FULTON (R. A.). **Two-spotted Spider Mite resistant to Aerosols.**
—*J. econ. Ent.* **44** no. 2 pp. 229–233, 9 refs. Menasha, Wis., 1951.

Parathion was widely used in aerosols against *Tetranychus bimaculatus* Harvey on plants in greenhouses in the eastern United States in 1948 and generally gave good results with fewer applications than had been necessary in 1947, when HETP (hexaethyl tetraphosphate) was effective. One rose grower in Connecticut, one in New Jersey and two in Pennsylvania, however, reported poor control. The Connecticut mites were investigated by P. Garman [*R.A.E.*, A **38** 426]. Tests in the other three establishments in February 1949 showed that mites in them were resistant to a parathion aerosol that gave good control in greenhouses in Maryland. Tests were then made with mites from the Pennsylvania and New Jersey infestations and from 33 other greenhouse establishments in Pennsylvania and Maryland in comparison with a laboratory culture reared on rose or bean. These showed that mites resistant to parathion were confined to the original three greenhouses and that mixed colonies of resistant and non-resistant mites did not occur. The distribution of resistant mites was gradually extended during late spring and summer, however, by the transference of infested plants from one of these

greenhouses, and by 1950 resistant mites were present in a large proportion of the rose houses in the eastern United States.

For further studies, resistant mites from New Jersey and Pennsylvania were established on bean or rose in the laboratory. In tests to compare the toxicity to them of various chemicals, mites from these colonies and from the non-resistant laboratory strain were transferred to young bean plants exposed to parathion, several other organic phosphorus compounds and three unrelated chemicals, 1,1-bis(p-chlorophenyl)ethanol, 2-chloroethyl 2-(p-tert-butyl-phenoxy)-1-methylethyl sulphite and p-chlorophenyl p-chlorobenzenesulphonate, all in aerosols. Mites resistant to parathion also showed various degrees of resistance to all the other compounds. Schradan (octamethyl pyrophosphoramide) was also tested in aerosols, in foliage sprays and soil treatments [cf. **39** 168-169]. It was toxic to resistant and non-resistant mites, but killed the latter 1-2 days earlier than the former. The results of these tests indicated that tetraethyl dithiopyrophosphate [cf. **38** 427], p-chlorophenyl p-chlorobenzenesulphonate and schradan were the most promising materials for controlling the resistant mites. When aerosol treatment with HETP or tetraethyl dithiopyrophosphate was repeated four times at intervals of three days, as in commercial practice, both compounds practically eliminated the susceptible mites and the second was superior to HETP against the resistant strain, though it was evident that at least five applications would be required to reduce the population to a low level.

Resistance to parathion was not lost when the mites were reared on bean or rose for ten months without exposure to insecticides [cf. **38** 426; **39** 169] or on 11 other crops or weeds in the greenhouse for shorter periods, but mites of the same species on weeds growing just outside greenhouses containing resistant forms showed no resistance. No morphological differences were found between resistant and susceptible forms, though colour variations occurred.

KERR jr. (T. W.). **Several injurious Ornamental and Shade Tree Insects and their Control.**—*J. econ. Ent.* **44** no. 2 pp. 234-240, 8 refs. Menasha, Wis., 1951.

The following is based on the author's introduction and summary. In further investigations on insects attacking ornamental trees and shrubs in Rhode Island [cf. *R.A.E.*, A **38** 428], the comparative effectiveness of various sprays and their timing were investigated in field tests against *Chalepus dorsalis* Thnb., *Hyphantria cunea* (Dru.), *Anisota senatoria* (S. & A.), *Phenacaspis pinifoliae* (Fitch), *Eulecanium* (*Lecanium*) *fletcheri* (Ckll.), *Pulvinaria floccifera* (Westw.), *E. (L.) coryli* (L.) and *E. (L.) quercifex* (Fitch). All spray quantities are per 100 U.S. gals. water.

DDT was more effective than either chlordan or lead arsenate against *C. dorsalis* on black locust [*Robinia pseudacacia*]. Three applications, each containing 2 lb. 50 per cent. wettable DDT, the first made one week after the first adults were observed and the second and third at intervals of seven and nine days, respectively, resulted in 92.3 per cent. control of the larvae, but caused perceptible yellowing of the older leaflets; 2-3 applications of 4 lb. lead arsenate with 1 lb. adhesive severely injured the foliage. Single applications of the same sprays gave 97 per cent. or more control of larvae of *H. cunea* on various trees and *A. senatoria* on oak, but DDT acted more rapidly than lead arsenate.

When applied in early May, 5 U.S. gals. petroleum oil gave complete control of eggs of *Phenacaspis pinifoliae* on pine. DDT, chlordan, aldrin [1,2,3,4,10,10-hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8-diendomethanonaphthalene],

dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and lindane [at least 99 per cent. γ benzene hexachloride] were ineffective as ovicides, but residues from the first two killed the newly hatched crawlers. In single applications, 1 U.S. pint nicotine sulphate and 2 lb. 50 per cent. wettable DDT gave 85.8 and 81.2 per cent. control, respectively, of first generation nymphs that had settled on the needles, whereas chlordan and lindane were ineffective against them. One application of the DDT spray was superior to two of the nicotine sulphate against the second generation female crawlers. Neither material had much effect on the male crawlers of the second generation.

One application of the DDT spray at the dormant stage in late April gave 99.7 per cent. control of females of *Pulvinaria floccifera* on yew (*Taxus media hicksi*), whereas aldrin and dieldrin were relatively ineffective. *P. floccifera* is the species previously recorded as *Pulvinaria* sp. [*loc. cit.*] All three materials were ineffective against females of *E. fletcheri* on the same trees.

Lime-sulphur, aldrin, dieldrin and chlordan were ineffective when applied as dormant sprays for the control of overwintered female nymphs of *E. coryli* on dogwood [*Cornus*]. One application of 3 U.S. pints nicotine sulphate gave 93.3 per cent. control of newly hatched nymphs on the leaves in July, whereas DDT and lindane were relatively ineffective. In mid-April, 2 U.S. gals. "superior" type dormant petroleum oil [*cf.* 38 109] applied to pin oak [*Quercus palustris*] gave 94.7 per cent. control of overwintered female nymphs of *E. quercifex*, but aldrin and dieldrin were ineffective.

MIDDLEKAUFF (W. W.). **Field Studies on the Bionomics and Control of the Broad Bean Weevil.**—*J. econ. Ent.* 44 no. 2 pp. 240–243, 3 figs., 2 refs. Menasha, Wis., 1951.

The growing of broad beans in California has been largely abandoned since about 1920 owing to the frequency and severity of infestation by *Bruchus rufimanus* Boh., which develops from larva to adult in the seeds and has only one generation a year. Observations and experiments on the control of the Bruchid with chemical compounds applied against the overwintered adults were begun in 1950. Dusts containing 5 per cent. DDT and 50 per cent. sulphur, with or without 1 per cent. crude BHC (benzene hexachloride), were applied from a helicopter to large fields, and 5 per cent. DDT, 1 per cent. lindane [at least 99 per cent. γ BHC], 5 per cent. DDD [dichlorodiphenyldichloroethane] or 2.5 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] with rotary hand dusters to small plots. In the large fields, 16.5–92.7 per cent. of untreated beans became infested, as compared with 1.5 per cent. of those dusted once with DDT and sulphur in June and 0.25–1.8 per cent. of those dusted once with DDT, BHC and sulphur in April, the only exception being in one field adjacent to an untreated one with an average of 80 per cent. infested beans, in which treatment with the mixture of DDT and BHC resulted in 33 per cent. infestation. No change in the flavour of beans from treated plants could be detected. In the small plots, DDT, DDD, dieldrin and lindane, applied once in April (probably a few days too late, as oviposition was well under way), reduced infestation to 6.1, 7.6, 7.9 and 9.3 per cent., as compared with 12.9 per cent. for no treatment. Subsequent surveys showed an excellent kill of adults on all treated plots.

It is concluded that one application of 5 per cent. DDT properly timed and applied to all broad bean fields in an area will prevent damage by *B. rufimanus*. As the eggs are not affected, applications should be made when not more than 1–2 eggs per 100 pods can be found. In 1950, eggs were first observed on 3rd April and were numerous by 24th May. Adults were found hibernating

under the bark of *Eucalyptus* on 31st March and again on 20th September ; the first adults emerged from the beans on 16th August.

HOLLOWAY (J. K.) & HUFFAKER (C. B.). **The Role of *Chrysolina gemellata* in the Biological Control of Klamath Weed.**—*J. econ. Ent.* **44** no. 2 pp. 244–247, 5 refs. Menasha, Wis., 1951.

The authors record that the initial colonies of *Chrysomela* (*Chrysolina*) *hyperici* Forst. and *Chrysomela quadrigemina* Suffr. (*Chrysolina gemellata* (Rossi)) introduced into California in 1944 for the control of the noxious weed, *Hypericum perforatum*, became established [cf. *R.A.E.*, A **37** 341] and that further importations became unnecessary two years after the first releases were made. *C. quadrigemina* showed much the greater rate of increase, and colonies of that species were established at the time of writing in all the 21 counties in which the weed is a problem. Some of the older colonies were already exerting control and had resulted in many acres of dead weed. The factors contributing to this success are discussed. Adults of *C. quadrigemina* emerge in April and May and feed voraciously on the foliage of *H. perforatum*, which is then in bud or in flower, until the plants become dormant in late June or early July, when they go into aestivation under stones or débris or in crevices in the soil. When rain falls in autumn, the weeds resume growth and the insects become active. The latter feed sparingly on the leafy procumbent basal growth formed by the plant, pair, and begin to oviposit about the middle of October. All stages can withstand winter temperatures. Larvae in the third and fourth instars feed on the basal growth, which they completely destroy. Early in spring, the plants that have escaped destruction develop upright shoots that are to become the flower-bearing stalks, and at this time the larvae become full-fed, enter the soil to a depth of about an inch and form cells in which to pupate.

The two species of *Chrysomela* differ only slightly in environmental requirements, but conditions in California permit an enormous increase of *C. quadrigemina* and curtail that of *C. hyperici*. When the autumn rains begin and the weed develops its basal growth, *C. quadrigemina* readily comes out of aestivation and begins to reproduce immediately, whereas *C. hyperici* reacts to moisture very slowly and is therefore deprived of opportunity for propagation when the plant growth is in a favourable condition. *C. quadrigemina* deposits the bulk of its eggs in autumn and early winter, and its larvae are often advanced in development by the time *C. hyperici* begins to oviposit in quantity. As a result of this delay in reproducing in autumn, the development of *C. hyperici* lasts so long that the dry soil conditions that occur from about April to October destroy the great mass of the population. Only individuals from the first eggs deposited or those able to find moist crevices complete their development, and thus large populations of eggs and larvae give rise to insignificant numbers of adults. In one highland area, in which moist conditions are prolonged until much later in the spring than in other weed-infested areas, *C. hyperici* had increased rapidly and was controlling the weed, and irrigation of a dry area from mid-August until November also enabled *C. hyperici* to reproduce to as great an extent as *C. quadrigemina*. Laboratory tests showed that larvae of *C. hyperici* are unable to enter perfectly dry soil, and that if the soil is only slightly moist, many can enter it, but only a few adults emerge.

Observations on the mode of dispersion of *C. quadrigemina* showed that in the early stages of an initial colonisation, the beetles move outward from a release centre primarily by crawling and do so mostly after aestivation, the females ovipositing as they go, but that when a population has reached an advanced stage and the larvae have defoliated nearly all the weeds present, the newly emerged adults are sometimes stimulated to flight by hunger on bright warm

days. Natural spread is rapid after the third or fourth year, and at this stage one control area had increased to about 100 sq. miles in extent.

It is expected that control of *Hypericum* by *C. quadrigemina* will progress rapidly in California, but the ultimate result will depend on competition from other range plants, reinfestation by weed seedlings, the ability of the beetles to spread to new infestations and to survive on very small patches of weed, and the possible appearance of natural enemies.

TOMLINSON JR. (W. E.). Control of Insect Larvae infesting immature Blueberry Fruit.—*J. econ. Ent.* **44** no. 2 pp. 247-250, 3 refs. Menasha, Wis., 1951.

In New Jersey, the immature fruits of cultivated blueberry are infested by *Mineola vaccinii* (Ril.), *Cydia* (*Grapholitha*) *packardii* (Zell.) and *Conotrachelus nenuphar* (Hbst.); the larvae of the last of these have shown a steady and consistent increase for six seasons, and it is now among the most serious insect pests of the immature fruits in several fields in the State. The flowering period of blueberries usually lasts 3-4 weeks on individual bushes, so that the berries that set first attain a fair size before the last of the bloom has dropped. *Mineola* and *Conotrachelus* begin to oviposit as soon as the first few berries have begun to grow, but investigations in 1950 showed that moth flight and egg deposition of *Cydia* are slight until near the end of the flowering season.

Various sprays were tested against these insects in 1948-50; the quantities are given per 100 U.S. gals. spray. The results were estimated by the numbers of larvae leaving a known volume of fruits. In one field in 1948, infestation by *Mineola* and *Cydia* was reduced by 89.1 and 81.6 per cent., respectively, as compared with no treatment, after two applications in May of 4 lb. cryolite and by 74.7 and 33.4 after two of 2 lb. 50 per cent. wettable DDT, but the cryolite injured the fruits and foliage. In the same field in 1949, two applications in May of 2 lb. 50 per cent. wettable methoxy-DDT (methoxychlor), alone or with 24 oz. 15 per cent. parathion, or two of 2 lb. 50 per cent. DDD (TDE) [dichlorodiphenyldichloroethane] gave more than 60 per cent. control of *Cydia* and were among the best against *Mineola*, which, however, was so scarce that the results were probably not significant. Cryolite, rotenone, lindane [at least 99 per cent. γ BHC (benzene hexachloride)], toxaphene, parathion alone and DDT were less effective, and cryolite was again injurious to the plants. In 1950, two applications in May and one in June of 2 lb. methoxy-DDT or EPN 300 (27 per cent. ethyl p-nitrophenyl thionobenzene-phosphonate) or 3 lb. 50 per cent. DDD gave more than 80 per cent. control of *Cydia*, and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and *Ryania* were ineffective; *Mineola* was not present.

In small plots in another field in 1949, two applications in May of 2 lb. 50 per cent. chlordan or 25 per cent. aldrin gave about 75 per cent. control of *Conotrachelus*, lead arsenate and technical BHC were much less effective, and parathion, lindane and cryolite were useless, and in larger plots in 1950, two applications in June of 3 lb. 50 per cent. methoxy-DDT, or 2 lb. 50 per cent. methoxy-DDT with 2 lb. lead arsenate, gave very substantial reductions of all three species, whereas neither chlordan, aldrin nor lindane was effective against all of them. In the last test, the first spray was applied when 75 per cent. of the bloom had set and the second a week later.

On the basis of these results and because of its comparative safety to man, it is recommended that sprays of 3 lb. 50 per cent. wettable methoxy-DDT should be applied at the rate of 200 U.S. gals. per acre when 75 per cent. of the flowers have set and again 7-10 days later.

THOMPSON (C. G.). **A Granulosis of the Imported Cabbageworm.**—*J. econ. Ent.* **44** no. 2 p. 255. Menasha, Wis., 1951.

The author describes the symptoms of a virus granulosis similar to those found in *Peridroma saucia* Hb. (*margaritosa* (Haw.)) and *Junonia coenia* Hb., which appeared in larvae of the second generation of an insectary stock of *Pieris rapae* (L.) originating from adult females collected in Albany, California. All of 30 individually reared larvae died in 7–8 days after being infected by feeding on leaves that had been dipped in a water suspension of virus material.

In cross-infectivity tests, larvae of *Peridroma saucia*, *J. coenia*, *Sabulodes caberata* Gn. and *Estigmene acraea* (Dru.), the only other insects in California in which granuloses are known to occur, were not susceptible to the granulosis of *Pieris*, and *Pieris* was not infected in feeding tests with viruses from these other insects.

THOMPSON (C. G.). **Field Tests during 1950 using a Polyhedrosis Virus to control the Alfalfa Caterpillar.**—*J. econ. Ent.* **44** no. 2 pp. 255–256, 2 figs., 2 refs. Menasha, Wis., 1951.

Tests on the control of *Colias eurytheme* Boisd. on lucerne in California by the artificial dissemination of the virus, named *Borrelina campeoles* by Steinhaus, that causes polyhedral disease in this Pierid were begun in 1948 [cf. *R.A.E.*, A **38** 201] and continued in 1949 and 1950. Suspensions of the virus were prepared by the method already described [*loc. cit.*] and applied by back-pack sprayer or aeroplane in 21 tests, in almost all of which complete mortality of the larvae resulted. One test in 1950 is described as an example. In it, 5 U.S. gals. per acre of a water suspension containing 10 million polyhedra per ml. was applied by aeroplane to lucerne when damage to the crop was already appearing, most of the larvae were in the third or fourth instar and adult emergence was just beginning. Considerable damage to the crops continued for four days, but 14 days after treatment, the lucerne appeared to have recovered completely and no larvae could be found. Adults emerged for four days after treatment, but none could subsequently be reared from pupae collected in the field. Untreated lucerne was completely destroyed, and most of the larvae on it gave rise to adults. Some parasitism occurred, but most of the mortality was due to the disease. The timing of the applications proved to be the critical factor in controlling the insect before it caused serious damage to the crop. Allowance has to be made for the 4–6 days after treatment during which the larvae continue to feed, and the incubation period is shorter at higher daily temperatures. It is advantageous to withhold application of the virus until most of the larvae are in the second or third instar, so that the degree of parasitism by *Apanteles medicaginis* Mues. can be determined. This Braconid frequently controls *C. eurytheme* to such an extent that treatment is unnecessary, but it was found that if treatment was delayed so long, fields with extremely high populations would be almost defoliated before the virus took effect.

The tests in 1950 indicated that to prevent economic injury, fields with potential maximum populations of 50 larvae per two sweeps of the net should be treated when the majority are in the third instar, potential populations of 50–100 when the population is about equally divided between the second and third instars, 100–150 when it is mostly second-instar or younger, 150–200 when the larvae are in the first and second instars and 200 or more soon after the first larvae have hatched and while most of the insects are in the egg stage.

In 1948, unpurified virus material was stored in glass jars in an open shed, in refrigerators at 2°C. and –30°C. [35.6 and –22°F.] or quick frozen in dry ice and alcohol and then stored at –30°C. The samples were compared with fresh

virus material in field tests in 1950, and no loss of virulence was detected in any of them.

TASCHENBERG (E. F.). **Laboratory Rearing of Grape Berry Moth.**—*J. econ. Ent.* **44** no. 2 pp. 256–258, 1 graph. Menasha, Wis., 1951.

A method of rearing *Polychrosis viteana* Clem. in the laboratory in winter was developed in New York to provide material for toxicological and life-history studies. Infested clusters of grapes were picked just before the larvae became fully fed, usually in the first week of September, placed in layers on trays having hardware-cloth bottoms, and covered with grape leaves to provide pupation sites. The cocoons were later cut or picked from the leaves and stored at 34°F. until needed. From about the last week of December, lots of 1,200–1,500 cocoons were placed weekly on trays in a combined emergence and oviposition cage, which is described, and kept in a greenhouse in which the temperature varied from 65 to 85°F. but was maintained at about 80°F. from 5 to 7 p.m., when most oviposition occurred. The humidity was kept fairly high. The moths emerged in the lower part of the cage, and oviposition material was exposed in the upper half. This consisted usually of small bunches of grapes of varieties that were commercially available in winter and did not wilt when kept at high temperatures for about six days. The bunches were suspended in the cage each day from about 4 to 9 p.m., and the grapes bearing eggs were then separated and kept for hatching. By this method, it was possible to maintain a continuous population of 400–500 adults by mid-February.

Honey water was provided for the adults, and they congregated at it at times, but it was not known whether it was really necessary. It was found that the females would oviposit on waxed paper placed against a pane of glass in an otherwise dark cage, and 109 eggs were obtained by this method in nine days when the moth population was kept at about 100, but a higher oviposition rate is desirable for laboratory studies.

In tests on the effect of temperature, the average duration of the egg stage in days fell from 11.1 at a constant temperature of 60°F. to 3.4 at one of 85°F. and was 6.9 and 5.8 when the temperature alternated in periods of 12 hours between 60 and 75°F. and between 60 and 85°F., respectively.

FRAZIER (N. W.). **New Aphid Vectors of Strawberry Viruses.**—*J. econ. Ent.* **44** no. 2 pp. 258–259, 4 refs. Menasha, Wis., 1951.

The common strawberry Aphid of the United States, which is referred to as *Capitophorus fragaefolii* (Ckll.), though its identity is uncertain [*cf. R.A.E.*, A **30** 210], was the only Aphid known to transmit strawberry virus there [*cf. 22* 188 ; **26** 291], but tests with eight other species of Aphids in connection with an investigation of the strawberry virus complex in California showed that five of them were experimental vectors. Of these, *C. (Myzaphis) rosarum* (Wlk.) and *Myzus porosus* Sand. were found only on cultivated rose, and *Amphorophora rubi* (Kalt.), *Macrosiphum pelargonii* (Kalt.) and *Myzus ornatus* Laing were collected on *Fragaria* spp. The Aphids that failed to transmit virus, *Cerosiphia (Aphis) forbesii* (Weed), *Macrosiphum solanifolii* (Ashm.) and *M. (Myzus) solani* (Kalt.), were all collected on *Fragaria* spp.

The sources of virus used included naturally diseased strawberry plants of commercial varieties infected with unknown viruses, leaves of these naturally infested with Aphids, and experimentally infected test plants such as the wild *F. bracteata* and wild strawberry (*F. vesca*), including a runnerless strain of an Alpine variety of the latter. The feeding period on the source of virus ranged from four hours to seven days and that on the healthy indicator plants from four hours to 11 days.

The viruses transmitted were all of the relatively non-persistent type [cf. 36 313] and have not been identified, though the symptoms produced on the indicator plants were largely of the crinkle variety. No transmission of persistent virus occurred, but few of the tests combined sufficiently long feeding periods on both sets of plants to fulfil the requirements necessary for the transmission of the known persistent viruses of strawberry. All viruses transmitted were retransmitted to further indicator plants by *Capitophorus fragaefolii*.

There was preliminary evidence of a certain degree of specificity between some of the demonstrated vectors and the particular viruses they transmitted. None of the five new vectors appeared to be as efficient as *C. fragaefolii*, and no investigations were made as to whether they may be a factor in the spread of virus in the field.

QUESTEL (D. D.) & BRADLEY (W. G.). **Mortality of Aphids and European Corn Borers feeding on Corn Plants grown in Soil treated with Bis(2-(2-fluoroethoxy)ethoxy) methane.**—*J. econ. Ent.* 44 no. 2 pp. 259-260, 1 fig., 4 refs. Menasha, Wis., 1951.

An account is given of investigations carried out in Ohio in 1949 on the effect of applications of bis(2-(2-fluoroethoxy)ethoxy)methane to the soil in which maize plants were growing in rendering the latter toxic to *Aphis maidis* Fitch and young larvae of *Pyrausta nubilalis* (Hb.).

In the first test, plants ten inches high growing in 5-inch pots in a greenhouse were heavily infested with the Aphid, and 1 cc. of the compound mixed with 20 gm. finely ground phosphate rock was applied to the soil surface, a little water added and the mixture covered with soil. None of the mixture was allowed to touch the aerial parts of the plants, and on a plant basis, the application was at the rate of about 6 lb. toxic ingredient per acre. Many Aphids had dropped from the plants four hours after treatment, 90 per cent. were dead after 20 hours and all after 72 hours, whereas Aphids on plants in untreated soil were healthy and reproducing normally. Although leaves of treated and untreated plants intermingled, there was no toxic action on Aphids on untreated plants, indicating that toxicity was due to systemic action (translocation in the plants) rather than fumigation.

In further tests, leaf sections were taken from all parts of 14-inch plants in 5-inch pots 4-18 days after 0.25 cc. per pot of the compound had been poured on the soil and water added to carry it down to the roots. They were rolled into small coils and inserted into stoppered test-tubes containing one or more egg-masses of *P. nubilalis* about to hatch, and caused complete mortality of the young larvae within 48 hours. When 12-inch plants growing at the rate of 5-8 per pot in 5-inch pots were infested with newly hatched larvae of *P. nubilalis*, and the soil was treated three days later with 0.25 cc. of the compound in 25 cc. water, complete mortality occurred in five days and the plants were showing uninjured new growth in the whorls in seven days. Untreated plants were severely injured by that time.

A slight scorching of the edges of the leaves resulted from the application of the compound to the soil at the rate of 0.25 cc. per 5-inch pot, and stunting of the plant and the destruction of many leaves from a dosage of 1 cc.

FLOCK (R. A.). **Damage to Household Goods by the Fan Palm Caterpillar.**—*J. econ. Ent.* 44 no. 2 pp. 260-261, 2 refs. Menasha, Wis., 1951.

Larvae of *Litoprosopus coachella* Hill feed on the flowers and flower shoots and to some extent on the fruits of the fan palms, *Washingtonia filifera* and *W. robusta*, which are common ornamental trees in southern California and Arizona. They normally make their cocoons of the tough fibre at the base

of the trees, but occasionally enter houses and damage household fabrics in their search for material from which to make them [cf. *R.A.E.*, A 36 400]. This usually occurs when large numbers of mature larvae are blown from the trees by wind, but a certain number fall or travel to the ground regardless of wind conditions, and when on the ground they appear to be attracted to lights and so are likely to enter buildings before finding suitable places to pupate.

The palms are in flower from April to October, and the larvae were observed from 15th June to 15th October 1944 at Phoenix, Arizona, and until 1st November 1950 at Riverside, California, but are most numerous from July to September. Adults have been taken in different years from 25th July to 6th October at Phoenix. The larvae are readily destroyed by the application of DDT to the crown of the tree in June or July or of a stomach poison to the flowering shoots. Removal of the flowering shoots early in the season may be equally effective. Lighted doors near infested trees should be closed tightly at night.

BOTIGER (G. T.) & YERINGTON (A. P.). **Comparative Toxicity of Tetraethyl Dithiopyrophosphate, Tetraisopropyl Pyrophosphate, and Parathion.**—*J. econ. Ent.* 44 no. 2 pp. 261–262, 2 refs. Menasha, Wis., 1951.

The results are given of laboratory experiments in which parathion, tetraethyl dithiopyrophosphate and tetraisopropyl pyrophosphate were tested in dips against *Paratetranychus citri* (McG.) and *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)), in dusts against *Haltica* (*Altica*) *ambiens* Lec., *Leucania* (*Cirphis*) *unipuncta* (Haw.), *Oncopeltus fasciatus* (Dall.) and *Tetranychus bimaculatus* Harvey and in sprays against the last three of these. Because of the low solubility of the three phosphates in water, a 1:9 mixture of acetone and water was used in preparing the dips and sprays, with 1 per cent. saponin as a wetting agent; the diluent in the dusts was fuller's earth.

Preliminary tests were made against *P. citri* to determine the concentrations necessary to kill about 25, 55 and 85 per cent. of the active mites, and replicated experiments were then made with these concentrations. Mortality was ascertained about 24 hours after treatment and plotted against concentration on log-probit paper. The graphs showed that the median lethal concentrations of parathion, tetraethyl dithiopyrophosphate and tetraisopropyl pyrophosphate were 0.167, 0.37 and 2.18 parts per million, respectively. In similar tests, the median lethal concentrations were 62.5, 3.125 and 940 p.p.m. for the eggs of *P. citri* on orange fruits and 0.24, 1.28 and 32 for adults of *M. onobrychis* on bean leaves. In the tests with sprays and dusts, treatment was applied to both surfaces of foliage infested by *H. ambiens* and *L. unipuncta* and directly to *O. fasciatus* and *T. bimaculatus*. In all experiments, parathion proved to be very much more toxic than the other compounds and tetraisopropyl pyrophosphate rather less toxic than tetraethyl dithiopyrophosphate.

Water suspension sprays containing 0.2 per cent. parathion, tetraethyl dithiopyrophosphate or tetraisopropyl pyrophosphate with 1 per cent. saponin, applied twice at an interval of seven days, had caused no damage a week after the second treatment to young plants of several vegetables growing under field conditions.

WOLCOTT (G. N.). **The Termite Resistance of Pinosylvlin and other new Insecticides.**—*J. econ. Ent.* 44 no. 2 pp. 263–264, 6 refs. Menasha, Wis., 1951.

Pinosylvlin (or 3,5-hydroxystilbene) is a diphenolic compound extracted from the heartwood of Scots pine [*Pinus sylvestris*] that is insoluble in water but

dissolves instantly in alcohol or acetone, forming a solution that can be diluted indefinitely with water without precipitation of the crystals. In tests in Porto Rico against *Kaloterms* (*Cryptoterms*) *brevis* (Wlk.) [cf. *R.A.E.*, A 39 59, etc.] samples of the wood of *Poinciana* (*Delonix*) *regia* were immersed for ten minutes in a solution of 0.01 per cent. pinosylvin and exposed to the termites in a petri dish on the following day, together with samples treated with other chemicals. For two months, no termites survived for longer than 2-3 days in the dish containing this sample; no other chemical has proved toxic at such a great dilution or for so long a time as this.

Pinosylvin was not available commercially, and further tests were made with *trans*-stilbene (referred to as E-1817), which can be dissolved in benzene or acetone, making a colourless and odourless solution for the impregnation of wood. A sample treated with a 0.01 per cent. solution was toxic to termites for several weeks, and although the termites attacked it after less than three months, it proved toxic to them and additional termites confined with it died rather than eat it.

The results of these tests and of similar tests with other materials are shown in a table. Of the other materials, samples treated with 0.05 per cent. *Ryania* extractive or dimethyl tetrachlorophthalate were not attacked in 18 months. Methoxy-DDT (methoxychlor) was the only one of several analogues of DDT to prove more effective than DDT itself [cf. 38 200], and wood impregnated with a 0.05 per cent. solution of it was not attacked in a year. Wood treated with 0.2 per cent. copper pentachlorophenate was not attacked throughout a period of almost seven years [cf. 38 200].

TOMLINSON jr. (W. E.). Influence of Temperature on Emergence of the Blueberry Maggot.—*J. econ. Ent.* 44 no. 2 pp. 266-267, 5 refs. Menasha, Wis., 1951.

The following is based on the author's summary. Records of the emergence of adults of the blueberry maggot [*Rhagoletis pomonella* (Walsh)] in outdoor cages in New Jersey in 1946-50 and observations of infested blueberry fruits in early July indicated that emergence normally occurred earlier than had been thought, beginning in early June, and that dusting on 30th June [cf. *R.A.E.*, A 32 282] was too late to protect blueberries that ripened early. Initial emergence in the cages was generally found to occur when the sum of the daily mean temperatures after 1st March was 5,215°F. or when the sum of the daily mean temperatures above 43°F. totalled 1,083°F. Soil temperatures were less useful because of the greater number of variables and the need for more expensive equipment. Observations in the cages indicated that the first application should be made 14-16 days after the first adults have emerged, according to the earliness or lateness of the season. Up to four applications are required.

FEINSTEIN (L.) & HANNAN (P. J.). Effect of Green Peach Aphid Damage on the Nicotine Content of Tobacco.—*J. econ. Ent.* 44 no. 2 p. 267. Menasha, Wis., 1951.

Myzus persicae (Sulz.) became very numerous on tobacco in the United States in 1946-48, and its effect on the nicotine content of the crop was investigated. Analysis of air-dried material from plants collected in South Carolina and Tennessee in 1947 and 1948 showed consistently less nicotine in tobacco damaged by the Aphid than in undamaged tobacco, though in a few instances the difference was so slight as to be within the limits of error of the analytical method.

BLACK (L. M.). **Transmission of Clover Club-leaf Virus through the Egg of its Insect Vector.** (Abstract.)—*Phytopathology* **38** no. 1 p. 2. Lancaster, Pa., 1948.

In experiments in the United States, adults of the Jassid, *Agalliopsis novella* (Say), infected with the clover club-leaf virus (*Aureogenus clavifolium* of Black) were allowed to deposit eggs in lucerne. Later, each of 30 nymphs was removed from the lucerne as soon as it had hatched, so that it had no opportunity to feed on the plant in which the egg was laid. Each nymph was placed on a seedling of crimson clover (*Trifolium incarnatum*) and transferred at weekly intervals to fresh seedlings until the insect died. Three died within two weeks, and the remaining 27 lived for 13–33 weeks. The clover test plants and an equal number of control plants were grown in a greenhouse for at least six weeks after the removal of the insects, and it was found that 24 of the 27 insects transmitted the virus. None caused infection until at least 3 weeks had elapsed from the time of hatching. The best transmission occurred during the 7th to 11th weeks. Altogether, 68 of the 642 test plants and none of the controls became infected. Only one other instance of a plant virus being transmitted through the egg of its insect vector is known [*cf.* R.A.E., A **29** 272].

HAGEDORN (D. J.). **Three Viruses of Canning Pea.** (Abstract.)—*Phytopathology* **38** no. 1 p. 11. Lancaster, Pa., 1948.

Three apparently undescribed viruses were isolated from peas grown for canning in Wisconsin. One produced mottle of the leaves, another caused streaking of the stem and the third brought about stunting of the plant. Host-range tests indicated that all three are limited to leguminous plants. The mosaic and stunt viruses were transmitted by *Macrosiphum onobrychis* (Boy.) (*Illinoia pisi* (Kalt.)), but attempts to transfer the streak virus by this means yielded negative results.

WRIGHT (C. M.) & BLODGETT (F. M.). **A Detached Leaf Method for Vector Studies with the Tomato-spotted-wilt Virus.** (Abstract.)—*Phytopathology* **38** no. 1 p. 28. Lancaster, Pa., 1948.

Thrips tabaci Lind. was successfully reared in the laboratory on potato or tomato leaflets placed in petri dishes containing water. Nymphs were confined on the detached leaflets by a ring of adhesive. Emerging adults were placed in microcages mounted on leaflets. Some adults that had previously fed as nymphs on potato leaflets infected with the virus of spotted wilt produced local lesions when they were confined on healthy detached petunia leaves. These lesions appeared three days after the infective adults were allowed to feed on the petunia leaves, and were similar in appearance to lesions resulting from mechanical inoculation with the virus. The study indicated the importance of maintaining pedigree cultures of thrips, of testing for the presence of the virus in the leaflets on which the nymphs were to be confined, and of mechanically inoculating one-half of the petunia leaf with the virus to make certain that it reacts with local lesion formation. Leaves of tobacco or *Nicotiana glutinosa* could not be used to test the infectivity of the adults because the thrips failed to feed when confined on them.

NIENOW (I.). **The Identification and Characterization of a Virus causing Mosaic in *Mertensia virginica*.**—*Phytopathology* **38** no. 1 pp. 62–69, 1 fig., 16 refs. Lancaster, Pa., 1948.

A virus causing mosaic in *Mertensia virginica* in Illinois, the properties of which are described, was identified by serological tests, cross protection tests,

host range, and transmission by *Myzus persicae* (Sulz.), as *Cucumis* virus I of Smith. It was transmissible to many different plants and produced symptoms dependent on the species. *Mertensia virginica* is a new host and an important reservoir, as it is a perennial and the virus persists in it.

ALEKSIDZE (N. E.). **Алексидзе (Н. Е.). On the Control of the Leaf Form of *Phylloxera*.—*Vinodelie i Vinogradarstvo* SSSR 9 no. 6 pp. 19–21. Moscow, 1949.**

The practice of grafting grape vines on stocks that are resistant to *Phylloxera* [*vitifoliae* (Fitch)] is common in the Soviet Union and requires the production of large numbers of stocks and control of the leaf form of the Aphid, which reduces their growth. In experiments in Georgia on the value of removing the first 4–6 leaves to destroy the fundatrices, galls appeared on the leaves of 10 per cent. of the plants thus treated. It was subsequently found that the fundatrices settled on the first 9–10 leaves, on unopened leaves at the tip, and also on the basal leaves beneath lumps of soil. The removal of the young shoots or hand-collection of leaves bearing galls was ineffective, and earthing up the crown and stem of the vine in summer, so as to leave only the shoots of the current year exposed, did not prevent the formation of leaf galls in the following year.

Good results were obtained, however, when earthing up was carried out in winter or spring so as to delay development of the vines until after the fundatrices had hatched from the winter eggs. In this way, leaves were not available for the fundatrices, which died of starvation. It was found that the fundatrices hatched over a period of about 10 days and when starved, lost their ability to feed after 24 hours at low humidity and 45 hours at high humidity, though they survived for 30 and 50–60 hours, respectively. It was sufficient therefore to delay the appearance of the leaves for 15–20 days. Details are given of experiments in 1936–39 in which the crown and stem of the plants were earthed up at various dates in winter or spring. The leaves were completely protected from galls until the third generation of the Aphid, in July, the amount of grafting material was considerably increased, and shoots were produced over a longer period. The appearance of a few galls on the leaves in July is attributed to carriage of the Aphids by wind from the control plants, which had become heavily infested. For adequate protection, the soil should be heaped up to a height of 3–4 ins., and if this is done in autumn or winter, the hill should be restored to this height in spring before the buds swell.

HELSON (G. A. H.). **The Potato Moth, *Gnorimoschema operculella* (Zell.) and its Control in Australia.**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 248, 27 pp., 17 refs. Melbourne, 1949.

A detailed account is given of work on the control of *Gnorimoschema operculella* (Zell.) on potato in Australia during 1942–46, much of which has already been noticed from less detailed sources. The investigations, which were carried out in New South Wales and at Canberra, comprised tests with dusts for the control of infestation in stored tubers [*R.A.E.*, A 36 217], in which 0.1 per cent. DDT in ferric oxide proved as effective as 1 per cent., laboratory and field tests with insecticidal sprays and dusts for controlling the larvae in the field [33 323 ; 35 160, 161 ; 36 217], tests of varietal susceptibility, and a field test of the protective value of removing the haulms just before harvest. This last slightly reduced tuber infestation but considerably reduced the total yield of tubers, and is not therefore considered to be an economic measure. The varietal tests showed that recently developed, high yielding varieties are more susceptible than an older variety that is no longer grown to any extent, and that the latter produced a greater weight of uninfested tubers, although its total yield was lower.

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- REVUE DE PHYTOPATHOLOGIE APPLIQUÉE (PARIS): Tome 1 (April-May, 1914) Nos. 22-23.
- REVUE DES SCIENCES MÉDICALES, PHARMACEUTIQUES ET VÉTÉRINAIRES DE L'AFRIQUE FRANÇAISE LIBRE. (BRAZZAVILLE): Tome 1 (1942) Nos. 3-4.
- REVUE SCIENTIFIQUE DU BOURBONNAIS ET DU CENTRE DE LA FRANCE (MOULINS): Ann. 1939-43.
- RHODESIA AGRICULTURAL JOURNAL (SALISBURY): Vol. 1 Nos. 1, 3-6; 2 Nos. 2, 4; 3 Nos. 1, 2, 6; 4 No. 4; 5 No. 4 (1903-08); 7 (1909-10) Nos. 1 & 6; 10 (1912) No. 1; title-pages & indices to vols. 1, 2, 4, 5, 8, 9.
- SCIENCIA MEDICA (RIO DE JANEIRO): Anno 1 (1925) Nos. 2-3, 5-6; 2 (1926) Nos. 1-10, 12.
- SOAP & SANITARY CHEMICALS (New York, N.Y.): Vol. 20 (1944) No. 9; Blue book 1945.
- SOCIALIST SCIENCE AND TECHNICS (TASHKENT): Tom 5 (1937) No. 7; 6 (1938) Nos. 5, 8, 12; 7 (1939) Nos. 9-10.
- SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY: Report 1879-84.
- TENNESSEE AGRICULTURAL EXPERIMENT STATION (KNOXVILLE, TENN.): 10th (1897), 12th (1899) and 16th (1903) Annual Reports.
- TENNESSEE STATE BOARD OF ENTOMOLOGY (KNOXVILLE, TENN.): Bulletins 15, 24, 25, 28, 29, 34, 39.
- TIJDSCHRIFT OVER PLANTENZIEKTEN (WAGENINGEN): Jaarg. 1 (1895); 16-17 (1910-11).
- TIMEHRI: THE JOURNAL OF THE ROYAL AGRICULTURAL AND COMMERCIAL SOCIETY OF BRITISH GUIANA (DEMERARA): Third Series, Vols. 1 (1911) Nos. 1-2; 2 No. 2 to end; 3 No. 2 to end; 4-5 (1913-18).
- TRANSACTIONS OF THE NATURAL HISTORY SOCIETY OF FORMOSA (TAIWAN) (TAIHOKU): Vol. 11 (1921) No. 57; 34 (1944) No. 251-252.
- TRAVANCORE DEPARTMENT OF AGRICULTURE (TRIVANDRUM): Report for 1931-32.
- TRAVAUX DE LA SOCIÉTÉ DES NATURALISTES DE Leningrad (LENINGRAD): Vol. 53 (? 1924) livr. 1; 55 (? 1925) livr. 1; 64 (Zool. Sect.) (? 1936).
- TROPENPFLANZER (BERLIN): Bd. 42 (1939) Hefte 9-12 and index; Bd. 43 (1940) et seqq.
- TROPICHESKAYA MEDITSINA I VETERINARIYA (Moscow): God 8 (1930) Nos. 2-5.
- TRUDUI PO ZASHCHITE RASTENII (LENINGRAD): Series 3 vuip. 5 (1935).
- UNITED STATES DEPARTMENT OF AGRICULTURE (WASHINGTON, D.C.): Howard (L. O.): Report of the Entomologist, 1895.
- VIRGINIA. STATE INSPECTOR FOR SAN JOSÉ SCALE: 1st Annual Report 1896-97 (Richmond, Va., 1897); STATE ENTOMOLOGIST AND PLANT PATHOLOGIST: 4th Report (Richmond, Va., 1905).
- WEST INDIAN BULLETIN (BARBADOS): title-page & index to vol. 4.
- ZEITSCHRIFT FÜR DAS LANDWIRTSCHAFTLICHE VERSUCHSWESSEN IN ÖSTERREICH (VIENNA): 21 Jahrg. (1918) Hefte 1-3, 10-12.
- ZEITSCHRIFT DES WIENER ENTOMOLOGEN-VEREINS (DER ENTOMOLOGISCHEN GESELLSCHAFT) (VIENNA): Jahrg. 24 (1939) Hefte 9-12; 25-29 (1940-44).
- ZOOLOGICHESKIĖ ZHURNAL (Moscow): Vol. 18 (1939) Nos. 2-6; 19 (1940); 20 (1941); 21 (1942) Nos. 4 & 6; 22 (1943) No. 1; 23 (1946) Nos. 5-6; 26 (1947).
- AGRICULTURAL CHEMICALS (NEW YORK, N.Y.): Vol. 1 (1946) Nos. 1-2, 4-5.
- AGRICULTURAL JOURNAL, DEPARTMENT OF AGRICULTURE, BRITISH COLUMBIA (VICTORIA): Vol. 1 (1916), Nos. 1 and 2.
- AGRICULTURAL NEWS (BARBADOS): Nos. 1, 25, 26, 34, 66 (1902-04).
- AGRICULTURE AND ANIMAL HUSBANDRY IN INDIA (DELHI): 1937-38.
- AMERICAN JOURNAL OF VETERINARY RESEARCH (CHICAGO, ILL.): Vols. 1 & 2 (1940-41) Nos. 1-2.
- ANALELE INSTITUTULUI DE CERCETĂRI AGRONOMICE AL ROMÂNIEI (BUCHAREST): Tome 14 (1942).
- ANNALS OF THE QUEENSLAND MUSEUM (BRISBANE): No. 5.
- ARBEITEN DER BIOLOGISCHEN STATION ZU KOSSINO (Moscow): Lief. 1 (?1925).
- ARCHIVES DE L'INSTITUT D'HESSAREK (HESSAREK-KARADJ): Fasc. 1 (1939), 2 (1940).
- ARCHIVES DE L'INSTITUT PASTEUR DE TUNIS: 1906 fasc. 4; 1907 fasc. 1 & 3; 1908; 1909 fasc. 1-2, 4; 1910 fasc. 1-3; 1911 fasc. 3-4.

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- ARCHIVES DU MUSÉE ZOOLOGIQUE DE L'UNIVERSITÉ DE MOSCOU : Vol. 5 (?1938).
 ARIZONA COMMISSION OF AGRICULTURE AND HORTICULTURE (PHOENIX, ARIZ.): 1st-10th Annual Reports; Circulars 15-16 (1909-18).
 ARKHIV MINISTARSTVA POL'OPRIVREDE (BELGRADE): Svesk. 1-11, 19 et seq.
 ARQUIVOS DO INSTITUTO BACTERIOLOGICO CÂMARA PESTANA (LISBON): Vol. 1 (1906).
 BEE WORLD (BENSON, OXON): Vols. 1-2 (1919-21).
 BERICHT ÜBER DIE WISSENSCHAFTLICHEN LEISTUNGEN IM GEBIETE DER ENTOMOLOGIE während des Jahres 1914 (Berlin): Nos. 1 & 5.
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 BOLETÍN DE LA DIRECCIÓN DE ESTUDIOS BIOLÓGICOS (MEXICO): Tomos 1-2 (1924-25).
 BOLLETTINO DELLA SOCIETÀ ITALIANA DI BIOLOGIA SPERIMENTALE (NAPLES): Vols. 17 (1942) Nos. 5-6; 18-21 (1943-45).
 BULETINUL SOCIETĂȚII NATURALIȘTILOD DIN ROMÂNIA (BUCAREST): Nos. 1-7, 14 et seq.
 BULLETIN AGRICOLE DE L'ALGÉRIE-TUNISIE-MAROC (ALGIERS): Année 20 (1914) Nos. 7-9, 12-14.
 BULLETIN DU COMITÉ D'ÉTUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (PARIS): Année 1919 No. 1.
 BULLETIN ÉCONOMIQUE DE L'INDOCHINE (B: AGRICULTURE) (HANOI): 35e ann. (1932) janvier-février.
 BULLETIN DE L'INSTITUT DES RECHERCHES BIOLOGIQUES (PERM): Tome 1 (1923) fasc. 1-2.
 BULLETIN DE LA STATION RÉGIONALE PROTECTRICE DES PLANTES À LENINGRAD: Vol. 6 (?1927); 7 (1936) No. 2.
 BULLETIN OF THE STONEHAM MUSEUM (KITALA): Nos. 37, 41.
 CARIBBEAN FORESTER (NEW ORLEANS, LA.): Vol. 1 (1940) No. 1.
 CHACARAS E QUINTAES (SÃO PAULO): Indices to Vols. 10, 11, 12, 14; Vol. 42 (1930) No. 3.
 CHINESE MEDICAL JOURNAL (CHENGDU): Vol. 61A (1942) No. 1.
 CHOROBY ROŚLIN (WARSAW): T.1 cz.1 (1931).
 COMPTES RENDUS DES SÉANCES DE L'ACADÉMIE D'AGRICULTURE DE FRANCE (PARIS): Tome 8 (1922) No. 5.
 COMPTES RENDUS DE L'ACADÉMIE DES SCIENCES DE L'URSS (MOSCOW): (N.S.) Vols. 26 (1940) Nos. 8-9; 27 (1940); 28 (1940) No. 1; 33 (1941) Nos. 4-6; 41 (1943) Nos. 8-9; 44 (1944) Nos. 4-9; 45 (1944) No. 1; 48 (1945) Nos. 4-5; 54 (1946) No. 9; 55 (1947) No. 7; 56 (1947) No. 2.
 CYPRUS AGRICULTURAL JOURNAL (NICOSIA): Vol. 23 (1928) Pt. 3.
 DOKLADUI AKADEMII NAUK SSSR (MOSCOW): (N.S.) Vols. 57-58 (1947); 59 (1948) Nos. 8-9; 60 (1948) Nos. 1-3.

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